DOCUMENT RESUME

ED 410 412 CE 074 574

AUTHOR	Joerschke, John D.
TITLE	Exploring Technology Education: Introduction to Technology Education.
INSTITUTION	Multistate Academic and Vocational Curriculum Consortium, Stillwater, OK.
PUB DATE	1997-00-00
NOTE	417p.; For related documents, see CE 074 575-576.
AVAILABLE FROM	Multistate Academic and Vocational Curriculum Consortium, 1500 West Seventh Avenue, Stillwater, OK 74074; telephone: 800/654-3988; World Wide Web: http://www.mavcc.org (teacher edition, order no. 303301: $36; student edition, order no. 303302: $27; 6 or more student editions: $13.50 each).
PUB TYPE	Guides - Classroom - Learner (051) -- Guides - Classroom - Teacher (052)
EDRS PRICE	EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Career Education; *Career Exploration; Career Guidance; Critical Thinking; Laboratory Procedures; Laboratory Safety; *Learning Activities; Lesson Plans; Mathematical Applications; Postsecondary Education; Secondary Education; Teaching Guides; Teaching Methods; Technological Advancement; *Technology Education; Thinking Skills; Units of Study; Vocational Education

ABSTRACT

These instructional materials include a teacher's guide designed to assist instructors in organizing and presenting an introductory course in technology education and a student guide. The materials are based on the curriculum-alignment concept of first stating the objectives, developing instructional strategies for teaching those objectives, and then evaluating based on the objectives. The course contains six units, each designed for use in more than one class period: What Is Technology Education?; Basic Laboratory Safety; Measuring and Related Math; Thinking Skills; Career-Exploration Process; and Evaluating the Consequences of Using Technology. Each unit in the teacher edition includes some or all of the following: suggested activities, learning activities sheet, optional information sheets, optional assignment sheets, answers to assignment sheets, optional lab activity sheets, teacher supplements, written test, answers to written test, and unit evaluation form. In addition, the teacher edition includes a section on use of the publication, a competency profile, instructional and task analyses, academic and workplace skill classifications and definitions, and a related academic and workplace skills list. Each of the six instructional units in the student edition includes some or all of the following components of a unit of instruction: objective sheet, information sheet, assignment sheets, lab activity sheets, and student supplements. (KC)

****
*   Reproductions supplied by EDRS are the best that can be made   *
*   from the original document.   *
****

ED 410 412

Exploring Technology Education
Introduction to Technology Education

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)
☒ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
● Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

PERMISSION TO REPRODUCE AND
DISSEMINATE THIS MATERIAL
IN OTHER THAN PAPER COPY
HAS BEEN GRANTED BY

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)

CE074574

BEST COPY AVAILABLE

Exploring TECHNOLOGY EDUCATION

Introduction to Technology Education

Teacher Edition

MAVCC

BEST COPY AVAILABLE

Exploring Technology Education:

Introduction to Technology Education

Teacher Edition

Written by

John D. Joerschke, Technical Writer

Project coordinated by

Sue Jones, Curriculum Specialist
Multistate Academic and Vocational Curriculum Consortium, Inc.

Project developed by

The Multistate Academic and Vocational Curriculum Consortium, Inc.

Board of Directors

Jean McEntire, Arkansas, Chair
Sue Ethelbah, Alaska, Vice-Chair
Jim Fliehler, Iowa, Parliamentarian
Mervin Birdwell, Louisiana
Ben Clay, Kansas
Emmett Eary, Texas
Charles Hopkins, Oklahoma
Larry Nelson, South Dakota
Harley Schlichting, Missouri

Clark R. Harris, Executive Director

97-012492

303301

Cover art courtesy of the Agency for Instructional Technology (AIT).

©1997 by the Multistate Academic and Vocational Curriculum Consortium, Inc.

All rights reserved. No part of this book may be reproduced in any form or by any means without written permission from the publisher.

Printed in the United States of America by the
Oklahoma Department of Vocational and Technical Education
Stillwater, OK 74074-4364

Multistate Academic and Vocational Curriculum Consortium, Inc.
1500 West Seventh Avenue
Stillwater, OK 74074-4364

The Multistate Academic and Vocational Curriculum Consortium (MAVCC) does not discriminate on the basis of race, creed, color, national origin, sex, age, religion, veteran status, or qualified handicap.

Introduction to Technology Education

Teacher Edition

Table of Contents

Foreword ... v
Acknowledgments ... vii
Use of introductory materials ... ix
Use of this publication ... xi
Competency profile ... xv
Instructional/task analysis ... xix
Academic and workplace skill classifications and definitions ... xxiii
Related academic and workplace skills list ... xxv

Unit 1: What Is Technology Education? **Teacher page**

Suggested Activities ... 1
Learning Activities Sheet ... 5
Teacher Supplement
  1—Using the AIT Media Program ... 7
Optional Assignment Sheet
  1—AIT Media Questions for Discussion and Review ... 9
Optional Information Sheet
  1—Milestones of History ... 11
Optional Assignment Sheet
  2—Technology and Product Development ... 17
Optional Assignment Sheet
  3—Great Inventions: A Product of Human Creativity, Hard Work, and Technology Resources ... 21
Answers to Assignment Sheets ... 27
Written Test ... 29
Answers to Written Test ... 33
Unit Evaluation Form ... 35

Unit 2: Basic Laboratory Safety

Suggested Activities ... 37
Learning Activities Sheet ... 39
Optional Assignment Sheet
  1—Complete a Student Safety Pledge and a Parent/Guardian Consent Form ... 41
Answers to Assignment Sheets ... 43
Written Test ... 45
Answers to Written Test ... 55
Unit Evaluation Form ... 59

Unit 3: Measuring and Related Math

Suggested Activities ... 61
Learning Activities Sheet ... 63
Answers to Assignment Sheets ... 65
Written Test ... 73
Answers to Written Test ... 77
Unit Evaluation Form ... 79

Table of Contents

Unit 4: Thinking Skills **Teacher page**

Suggested Activities 83
Learning Activities Sheet 87
Optional Assignment Sheet
    1—Solve a Transportation Problem 89
Answers to Assignment Sheets 91
Optional Lab Activity Sheet
    1—Create and Construct a Container That Will Withstand a 10-Foot Drop 93
Written Test 97
Answers to Written Test 99
Unit Evaluation Form 101

Unit 5: Career-Exploration Process

Suggested Activities 103
Learning Activities Sheet 107
Optional Information Sheet
    1—Education and Training Levels 109
Optional Information Sheet
    2—Sample Plan of Action 111
Teacher Supplement
    1—Extra Copies of Student Supplements 2 through 8 113
Answers to Assignment Sheets 133
Written Test 135
Answers to Written Test 137
Unit Evaluation Form 139

Unit 6: Evaluating the Consequences of Using Technology

Suggested Activities 141
Learning Activities Sheet 145
Teacher Supplement
    1—Using the AIT Media Program 147
Optional Assignment Sheet
    1—AIT Media Questions for Discussion and Review 149
Answers to Assignment Sheets 151
Written Test 153
Answers to Written Test 155
Unit Evaluation Form 157

Foreword

Exploring Technology Education: Introduction to Technology Education is the first of five new publications that have been developed to replace MAVCC's original technology education series. The titles of the five new books in MAVCC's current technology education series are

- *Introduction to Technology Education*
- *Exploring Communication Technology*
- *Exploring Manufacturing Technology*
- *Exploring Construction Technology*
- *Exploring Energy, Power, and Transportation Technology*

The changes in the instructional materials in MAVCC's new technology education series reflect the changes that have occurred in industry as a result of emerging technology and the demand for more highly skilled workers who can read, write, find and interpret information, think creatively to solve problems, and then, effectively communicate their solutions to other people. As a result, the students who will use these instructional materials are asked to learn and use strategies for finding and presenting pertinent information and for thinking and problem-solving to complete the assignment and lab activity sheets that are the core of each unit of instruction in the series.

The success of this publication is due in large part to the capabilities of the personnel who worked with its development. Appreciation is extended to them for their valuable contributions to the publication.

These instructional materials are designed for student use and to assist instructors in organizing and improving instruction. These instructional materials are based on the curriculum-alignment concept of first stating the objectives (objective sheet), developing instructional strategies for teaching those objectives (information, assignment, and lab activity sheets), and assessing to those same objectives (written test—a criterion-referenced evaluation instrument).

Every effort has been made to make these instructional materials basic, readable, and by all means, usable. However, as with all of MAVCC's instructional materials, instructors must localize and personalize these materials to meet their community, classroom/laboratory, and individual student's situation. Instructors are encouraged to supplement the instructional materials and to develop strategies for motivating their students.

As you use these instructional materials, we hope that you will find that they contribute to the quality of your program. If any problems occur or if you have any suggestions for improving the materials, please call or write us.

Jean McEntire, Chair
Board of Directors
Multistate Academic and
Vocational Curriculum Consortium

Clark R. Harris
Executive Director
Multistate Academic and
Vocational Curriculum Consortium

Acknowledgments

Appreciation is extended to those individuals who contributed their time and talent to the development of *Exploring Technology Education: Introduction to Technology Education.*

Thanks are extended to the following technology education instructors who assisted the MAVCC staff in planning the revisions needed in the original technology education series.

Steve Adams
Technology Education Instructor
Cleveland High School
Cleveland, Oklahoma

Troy Bowers
Technology Education Instructor
Hobart High School
Hobart, Oklahoma

Gail Cobb
Technology Education Instructor
Pawhuska High School
Pawhuska, Oklahoma

Bobby Welch
Technology Education Instructor
Olustee Jr/Sr High School
Olustee, Oklahoma

Thanks are also extended to the following members of the Technology Education Division of the Oklahoma Department of Vocational and Technical Education for reviewing the rough drafts of the units of instruction as they were developed for this publication.

Lynn Hawkins
State Program Administrator

Donovan Bowers
Program Specialist

Harold Holley
Program Specialist

Thanks are extended, also, to Bob Davis, art department manager; Kathryn Moore and Suzi Currier, artists; Rose Primeaux, word processing supervisor: Karen Hart, word processing/desktop publishing operator; and the other employees of the Oklahoma Department of Vocational and Technical Education who assisted in the printing of these instructional materials.

Appreciation is also extended to the Agency for Instructional Technology (AIT) for providing the artwork used on the covers of the student and teacher editions of this publication.

Use of Introductory Materials

Introductory materials are included in the teacher edition only and contain useful information to assist administrators and teachers in planning for instruction.

In addition to the general information—such as the table of contents, foreword, and acknowledgments page—information is included on the following:

1. **Use of this publication**—Explains the components of a unit of instruction and how they should be used as part of the teaching/learning process.

2. **Competency profile**—Provides a record of student performance for each task included in a unit of instruction. This profile should become a part of the student's permanent course records.

3. **Instructional/task analysis**—Provides a quick review of the contents of the publication; identifies cognitive (knowledge) skills and psychomotor (doing) skills addressed in each unit of instruction.

4. **Academic and workplace skill classifications and definitions**—Defines the basic-skill classifications used by MAVCC. Skill areas reflected by skill groups, subskills, and descriptions have been identified using *What Work Requires of Schools: A SCANS Report for America 2000 and Workplace Basics: The Skills Employers Want*. These have been adapted by MAVCC.

5. **Related academic and workplace skills list**—Classifies unit tasks (assignment sheets and lab activity sheets) according to the related academic and workplace skills and competencies being reinforced.

As you use these materials, it is hoped that they will provide useful information to meet a variety of needs.

Use of This Publication

Instructional units

Exploring Technology Education: Introduction to Technology Education contains six units of instruction:

- Unit 1—What Is Technology Education?
- Unit 2—Basic Laboratory Safety
- Unit 3—Measuring and Related Math
- Unit 4—Thinking Skills
- Unit 5—Career-Exploration Process
- Unit 6—Evaluating the Consequences of Using Technology

Each of the six instructional units in the student edition of this publication includes some or all of the following components: objective sheet, information sheet, assignment sheets, lab activity sheets, and student supplements.

Each section in this teacher edition includes some or all of the following components for each of the six units of instruction: suggested activities, learning activities sheet, optional information sheets, optional assignment sheets, answers to assignment sheets, optional lab activity sheets, teacher supplements, written test, answers to written test, and unit evaluation form.

Units of instruction are designed for use in more than one lesson or class period of instruction, all of the unit components focus on measurable and observable learning outcomes, and careful study of the components in both the student and teacher edition for each unit of instruction by the teacher will help to determine the following:

- Amount of materials that can be covered in each class period.
- Skills that must be demonstrated.
- Amount of class time needed for teacher demonstrations.
- Amount of time needed for student practice.
- Supplementary materials, including print and nonprint media and equipment and supplies, that must be ordered.
- Resource people who must be contacted.

Student-edition components

It is a challenge to keep students motivated. Instructors should supplement the student-edition components by providing the "why," personal experiences, and current information. Prepare for each unit by deciding how each of the student components listed on the next page can best be taught, and by allowing students to become involved in preparing and planning their teaching/learning experiences.

Objective sheet. Each unit of instruction is based on performance objectives that state the goals for successful completion of the unit. These performance objectives are presented in two forms on each objective sheet: (1) a unit objective, which states the expected performance of each student after completion of the unit of instruction, and (2) specific objectives, which state what the student must do to reach the unit objective.

The instructor should stress the unit objectives throughout the teaching/learning process. Doing so will help answer student questions concerning performance requirements for each instructional unit. The objectives can also help the instructor determine teaching strategies and instructional methods. Teachers should prepare for each unit by deciding how each objective can best be taught.

Teachers should feel free to modify, delete, or add objectives to an objective sheet in order to meet the needs of the students and community. When objectives are added, however, the teacher should remember also to add the needed information-sheet, assignment-sheet, lab activity-sheet, and criterion-referenced written-test items.

Information sheet. The information sheet provides the students with the content essential for meeting the testable cognitive (knowledge) objectives of the unit; this means the cognitive information presented in the information sheet is tested in the criterion-referenced written test that is presented in the teacher edition for each unit of instruction.

Student supplements. The information presented in a student supplement may consist of tables, charts, written information, forms, or other information students must be able to apply in order to complete one or more of the assignment sheets or lab activity sheets in a unit of instruction. Students are not directly tested over the information presented in a supplement; however, their ability to apply this information should be evaluated in scoring the completed assignment sheet/lab activity sheet associated with a supplement.

Assignment sheets. The assignment sheets presented in a unit of instruction provide students with pencil-and-paper activities that give students the opportunity to apply the testable cognitive objectives presented in the information sheet and the nontestable cognitive information presented in student supplements. Criteria are provided on each assignment sheet to assist the instructor in objectively evaluating student performance.

Lab activity sheets. The lab activity sheets presented in a unit of instruction provide students with psychomotor activities that give students the opportunity to apply the testable cognitive objectives presented in the information sheet and the nontestable cognitive information presented in the student supplements.

A worksheet is included in each lab activity sheet. The worksheet provides criteria to allow the instructor to objectively evaluate student performance of the particular psychomotor skills presented in a lab activity sheet and also requires the student to check with the instructor to discuss the methods, equipment, and materials the student is planning to use in completing the psychomotor activity in that lab activity sheet.

Teacher-edition components

Suggested activities. The suggested activities component assists teachers during the preparation stage of the teaching/learning process by providing an instructional plan and a list of suggested resources to be used with each unit of instruction.

Use of This Publication

The teacher should read the instructional-plan section of the suggested activities component before presenting the unit to his or her students and decide how each objective can best be presented, how to obtain supplemental materials required for the unit presentation, and which outside resources will be required for the unit presentation.

The teacher should read both subsections of the "suggested resources" section of the suggested activities to obtain ordering information for books and media to supplement the subject area covered in a unit of instruction.

The subsection called "resources used in developing this unit" lists the books and materials that were used by the writer in doing research for a particular unit of instruction. These materials can be used by the teacher to supplement her or his knowledge of the subject area presented in the unit of instruction or to provide background information to students with particular interests or objectives in the subject area covered in the unit of instruction.

The "suggested supplemental resources" subsection provides ordering information for printed material or media presentations that instructors may want to use to supplement the subject area of the objectives presented in the unit of instruction.

Learning activities sheet. The learning activities sheet supplied in each unit is a step-by-step instruction sheet instructors may copy and distribute to students to guide their individual study through the required components in the student edition (objective sheet, information sheet, student supplements, assignment sheets, and lab activity sheets).

Optional information sheets, optional assignment sheets, and optional lab activity sheets. When these components are provided in the teacher edition for a unit of instruction, they are optional cognitive-information sheets, pencil-and-paper activities, and psychomotor activities. These optional activities may be duplicated for student use. They allow the instructor to use his or her discretion in providing students with additional objectives in the same subject area as the required objectives provided in the student edition for that particular unit.

Assignment-sheet answers. Assignment-sheet answers are designed to assist the teacher in evaluating student performances on both the required assignment sheets in the student edition and the optional assignment sheets in the teacher edition.

Written test. This component is a criterion-referenced evaluation of every cognitive objective listed in the information sheet in the student edition. If the instructor has added, deleted, or modified objectives in the student edition, appropriate changes should be made on the written test. The test is included in the teacher edition only, but duplication is permitted for student use.

A selection of test items from the units covered may be used for final tests at the end of each term if the instructor desires.

Written-test answers. This component is designed to assist the teacher in evaluating student performance on the written test.

Teacher supplements. Teacher supplements are optional materials for the teacher to use. They provide the teacher with state-of-the-art information in which the teacher may not have background or with information that is not readily available in other books.

Unit evaluation form. This form provides teachers with a record of each student's performance on a unit of instruction. It includes space for assignment-sheet ratings, lab activity-sheet ratings, written-test scores, and teacher comments. The unit evaluation form is included in the teacher edition only, but duplication is permitted for student use.

Competency Profile

Name: ______________________________

Directions: Evaluate the student using one of the optional rating scales below. Write the appropriate numbers/letters to indicate the degree of competency achieved. The descriptions associated with each of the numbers/letters focus on a level of student performance for each of the tasks listed. The written-test scoreline is provided for optional teacher use. It may not be applicable in all cases.

Optional rating scales

Option A

Rating scale: 4 — **Skilled** – Can perform job with no additional training.
3 — **Moderately skilled** – Has performed job during training program; limited additional training may be required.
2 — **Limited skill** – Has performed job during training program; additional training is required to develop skill.
1 — **Unskilled** – Is familiar with process, but is unable to perform job.
0 — **No exposure** – No information or practice provided during training program, complete training is required.
NA — **Non-applicable**.

Option B

Yes — Can perform job with no additional training.
No — Is unable to perform satisfactorily.

Unit 1: What Is Technology Education?

________ 1. Profile the technology resources and systems in your state
________ 2. Draw a systems model to analyze an industry, business, or company in your local area
________ 3. Explore the interrelationships of the functions of the types of technology systems
________ 4. ______________________________

________Written-test score

Unit 2: Basic Laboratory Safety

________ 1. Interpret portable fire-extinguisher symbols
________ 2. Determine correct laboratory safety practices
________ 3. Identify safety practices followed in your technology education laboratory
________ 4. ______________________________

________Written-test score

Competency Profile

Unit 3: Measuring and Related Math

________ 1. Add whole numbers
________ 2. Subtract whole numbers
________ 3. Multiply whole numbers
________ 4. Divide whole numbers
________ 5. Reduce fractions to lowest terms
________ 6. Convert mixed numbers to improper fractions and improper fractions to mixed numbers
________ 7. Add fractions
________ 8. Subtract fractions
________ 9. Add decimal numbers
________10. Subtract decimal numbers
________11. Multiply decimal numbers
________12. Divide decimal numbers
________13. Convert fractions to decimals
________14. Read U.S. customary and metric rules
________15. Compute U.S. customary/metric equivalents
________16. ____

________Written-test score

Unit 4: Thinking Skills

________ 1. Use the tools for understanding the creative process to analyze the nature of a recent innovation
________ 2. Use the tools of logical thinking to analyze a situation
________ 3. Apply the problem-solving process to improve the quality of a product or service
________ 4. Create and construct a device that will extinguish a candle flame
________ 5. Create and construct a vessel that will float and bear weight
________ 6. ____

________Written-test score

Unit 5: Career-Exploration Process

________ 1. Gather personal information
________ 2. Gather general job information and identify occupational area of choice
________ 3. Gather specific job information
________ 4. Make a career decision
________ 5. Develop a plan of action to meet career goal
________ 6. ____

________Written-test score

Competency Profile

Unit 6: **Evaluating the Consequences of Using Technology**

_______ 1. Evaluate the consequences of your television-watching habits
_______ 2. Evaluate the consequences of your family's present recycling habits
_______ 3. Collect a sample of the particulate matter in the air
_______ 4. ____________________

_______Written-test score

Comments: ____________________

Evaluator: ____________________ Date: ____________________

Permission to duplicate this profile is granted.

Instructional/Task Analysis

Related Information: What the student should know	Application: What the student should be able to do
Unit 1: What Is Technology Education?	
1. Definition of the term *technology education* 2. Definition of the term *technology* 3. Definition of the term *system* 4. Definition of the term *technology system* 5. Types of technology systems and their definitions 6. Stages in a basic technology systems model 7. Classifications of the resources used in the various types of technology systems 8. The interrelationship of the functions of the types of technology systems	9. Profile the technology resources and systems in your state 10. Draw a systems model to analyze an industry, business, or company in your local area 11. Explore the interrelationship of the functions of the types of technology systems
Unit 2: Basic Laboratory Safety	
1. Definitions of terms associated with laboratory safety 2. Applications for the colors used in the federal safety color code 3. General laboratory safety rules 4. Guidelines for maintaining a safe work area 5. Guidelines for dressing safely in the laboratory 6. Guidelines for preventing slips, trips, and falls 7. Guidelines for preventing electrical shock 8. Guidelines for preventing fire and fire spread 9. Guidelines for using flammable materials and toxic substances 10. Guidelines for using laboratory tools and power equipment 11. General steps for handling any emergency situation	12. Interpret portable fire-extinguisher symbols 13. Determine correct laboratory safety practices 14. Identify safety practices followed in your technology education laboratory

Instructional/Task Analysis

Related Information: What the student should know	Application: What the student should be able to do
Unit 3: Measuring and Related Math	
1. Definitions of terms associated with math and measuring	6. Add whole numbers
	7. Subtract whole numbers
2. The place values of a whole number	8. Multiply whole numbers
3. Types of fractions	9. Divide whole numbers
4. The place values of a decimal number	10. Reduce fractions to lowest terms
5. The values of prefixes associated with metric measurement	11. Convert mixed numbers to improper fractions and improper fractions to mixed numbers
	12. Add fractions
	13. Subtract fractions
	14. Add decimal numbers
	15. Subtract decimal numbers
	16. Multiply decimal numbers
	17. Divide decimal numbers
	18. Convert fractions to decimals
	19. Read U.S. customary and metric rules
	20. Compute U.S. customary/metric equivalents
Unit 4: Thinking Skills	
1. Major types of thinking skills and their definitions	4. Use the tools for understanding the creative process to analyze the nature of a recent innovation
2. Aspects of creative thinking and their definitions	5. Use the tools of logical thinking to analyze a situation
3. Aspects of logical thinking and their definitions	6. Apply the problem-solving process to improve the quality of a product or service
	7. Create and construct a device that will extinguish a candle flame
	8. Create and construct a vessel that will float and bear weight

Instructional/Task Analysis

Related Information: What the student should know	Application: What the student should be able to do
Unit 5: Career-Exploration Process	
1. Terms associated with career exploration and their definitions	3. Gather personal information
2. Steps in the career-exploration process	4. Gather general job information and identify occupational area of choice
	5. Gather specific job information
	6. Make a career decision
	7. Develop a plan of action to meet career goal
Unit 6: Evaluating the Consequences of Using Technology	
1. Why people must evaluate their use of technology	4. Evaluate the consequences of your television-watching habits
2. Two undesired consequences of using technology	5. Evaluate the consequences of your family's present recycling habits
3. Definition of the term *futuring process*	6. Collect a sample of the particulate matter in the air

Academic and Workplace Skill Classifications and Definitions

Skill group	Subskill	Definition
Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task.
	Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner.
	Arithmetic/ mathematics	Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques.
	Science	Applying knowledge learned through study and practice that is based on scientific principles, methods, and techniques.
	Listening	Receiving, interpreting, and responding to verbal messages and other cues.
	Speaking	Communicating a thought, idea, or fact verbally in a clear, concise manner.
Thinking skills	Creative thinking	Using imagination to generate new ideas.
	Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative.
	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results.
	Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information.
	Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills.
	Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem.
Personal-management skills	Responsibility	Exerting a high level of effort towards goal attainment, working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration.
	Self-esteem	Developing self-confidence and maintaining a positive view of self.
	Career awareness, development, and mobility	Assessing self accurately, setting personal goals, establishing and implementing a plan, and monitoring progress.
	Integrity/honesty	Choosing an ethical course of action when faced with making a decision that may break with personal or societal values and recognizing the impact of violating these beliefs and codes on an organization, self, and others.
	Organizational effectiveness	Adapting to the organization's goals, values, culture, and traditional modes of operation.

Academic and Workplace Skill Classifications and Definitions

Skill group	Subskill	Definition
Resources	Time	Selecting relevant, goal-related activities; ranking them in order of importance; allocating time; and understanding, preparing, and following schedules.
	Money	Using or preparing budgets, making forecasts, keeping records, and making adjustments to meet objectives.
	Material and facilities	Acquiring, storing, and using materials and space efficiently.
	Human resources	Assessing skills and distributing work accordingly; evaluating performance and providing feedback.
Interpersonal skills	Teamwork	Working cooperatively with others to reach a common goal.
	Coaching	Helping others learn new skills.
	Leadership	Communicating ideas to justify position; accepting responsibility for others; and encouraging, persuading, convincing, or otherwise motivating an individual or group.
	Negotiation	Resolving conflict between two or more individuals through discussion and compromise.
	Customer service	Working and communicating with customers to satisfy their expectations.
	Cultural diversity	Working well with men and women with a variety of ethnic, social, or educational backgrounds.
Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources or creating it, and evaluating its relevance and accuracy.
	Organization and storage	Organizing, processing, and maintaining written or computerized records and other forms of information in a systematic way.
	Interpretation	Selecting and analyzing information and communicating the results to others.
	Processing	Using computers to acquire, organize, analyze, and communicate information.
Systems	Interrelationships	Knowing how social, organizational, and technological systems work and operate effectively.
	Monitoring	Distinguishing trends, predicting impact of actions on system operations, diagnosing deviations in systems' performance, and correcting malfunctions.
	Modification and design	Making suggestions to modify existing systems to improve products or services, and developing new or alternative systems.
Technology	Selection	Choosing procedures, tools, or equipment including computers and related technologies.
	Application	Demonstrating proper procedures for setting up and operating equipment.
	Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment, including computers and other technologies.

Related Academic and Workplace Skills List

Task	Skill group	Subskill	Description
Unit 1: What Is Technology Education?			
Profile the technology resources and systems in your state (A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
		Reasoning	Applying a principle underlying the relationship between two or more objects when solving a problem
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how technological systems work and operate effectively
Draw a systems model to analyze an industry, business, or company in your local area (A.S. 2)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
		Speaking	Communicating a thought, idea, or fact verbally in a clear, concise manner
	Thinking skills	Creative thinking	Using imagination to generate new ideas
		Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy

BEST COPY AVAILABLE

Related Academic and Workplace Skills List

Task	Skill group	Subskill	Description
Unit 1: What Is Technology Education? (cont.)			
A.S. 2 (cont.)		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how social, organizational, and technological systems work and operate effectively
Explore the interrelationship of the functions of the types of technology systems (A.S. 3)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources or creating it, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how social, organizational, and technological systems work and operate effectively
Unit 2: Basic Laboratory Safety			
Interpret portable fire-extinguisher symbols (A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative
		Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem

Related Academic and Workplace Skills List

Task	Skill group	Subskill	Description
Unit 2: Basic Laboratory Safety (cont.)			
Determine correct laboratory safety practices (A.S. 2)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative
		Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
Identify safety practices followed in your technology education laboratory (A.S. 3)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
	Personal-management skills	Integrity/ honesty	Choosing an ethical course of action when faced with making a decision that may break with personal or societal values and recognizing the impact of violating these beliefs and codes on an organization, self, and others
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources or creating it, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
Unit 3: Measuring and Related Math			
Add whole numbers (A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Arithmetic/ mathematics	Performing basic computations and solving practical problems

Related Academic and Workplace Skills List

Task	Skill group	Subskill	Description
Unit 3: Measuring and Related Math (cont.)			
Subtract whole numbers (A.S. 2)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Arithmetic/ mathematics	Performing basic computations and solving practical problems
Multiply whole numbers (A.S. 3)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Arithmetic/ mathematics	Performing basic computations and solving practical problems
Divide whole numbers (A.S. 4)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Arithmetic/ mathematics	Performing basic computations and solving practical problems
Reduce fractions to lowest terms (A.S. 5)	Basic skills	Reading	Comprehending written information and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Arithmetic/ mathematics	Performing basic computations and solving practical problems
Convert mixed numbers to improper fractions and improper fractions to mixed numbers (A.S. 6)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Arithmetic/ mathematics	Performing basic computations and solving practical problems
Add fractions (A.S. 7)	Basic skills	Reading	Comprehending written information and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Arithmetic/ mathematics	Performing basic computations and solving practical problems

Related Academic and Workplace Skills List

Task	Skill group	Subskill	Description
Unit 3: Measuring and Related Math (cont.)			
Subtract fractions (A.S. 8)	Basic skills	Reading	Comprehending written information and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Arithmetic/ mathematics	Performing basic computations and solving practical problems
Add decimal numbers (A.S. 9)	Basic skills	Reading	Comprehending written information and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Arithmetic/ mathematics	Performing basic computations and solving practical problems
Subtract decimal numbers (A.S. 10)	Basic skills	Reading	Comprehending written information and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Arithmetic/ mathematics	Performing basic computations and solving practical problems
Multiply decimal numbers (A.S. 11)	Basic skills	Reading	Comprehending written information and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Arithmetic/ mathematics	Performing basic computations and solving practical problems
Divide decimal numbers (A.S. 12)	Basic skills	Reading	Comprehending written information and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Arithmetic/ mathematics	Performing basic computations and solving practical problems
Convert fractions to decimals (A.S. 13)	Basic skills	Reading	Comprehending written information and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Arithmetic/ mathematics	Performing basic computations and solving practical problems

BEST COPY AVAILABLE

Related Academic and Workplace Skills List

Task	Skill group	Subskill	Description
Unit 3: Measuring and Related Math (cont.)			
A.S. 13 (cont.)	Thinking skills	Seeing things in the mind's eye	Mentally organizing graphs and other information
Read U.S. customary and metric rules (A.S. 14)	Basic skills	Reading	Comprehending written information and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information
Compute U.S. customary/metric equivalents (A.S. 15)	Basic skills	Reading	Comprehending written information and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Arithmetic/ mathematics	Performing basic computations and solving practical problems
	Thinking skills	Seeing things in the mind's eye	Mentally organizing graphs and other information
Unit 4: Thinking Skills			
Use the tools for understanding the creative process to analyze the nature of a recent innovation (A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
	Interpersonal skills	Teamwork	Working cooperatively with others to reach a common goal
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources or creating it, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
Use the tools of logical thinking to analyze a situation (A.S. 2)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner

Related Academic and Workplace Skills List

Task	Skill group	Subskill	Description
Unit 4: Thinking Skills (cont.)			
A.S. 2 (cont.)	Thinking skills	Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources or creating it, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
Apply the problem-solving process to improve the quality of a product or service (A.S. 3)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
	Interpersonal skills	Teamwork	Working cooperatively with others to reach a common goal
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources or creating it, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how social, organizational, and technological systems work and operate effectively
		Modification and design	Making suggestions to modify existing systems to improve products or services, and developing new or alternative systems
Create and construct a device that will extinguish a candle flame (L.A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Creative thinking	Using imagination to generate new ideas

Related Academic and Workplace Skills List

Unit 4: **Thinking Skills** (cont.)

Task	Skill group	Subskill	Description
L.A.S. 1 (cont.)		Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative
		Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
	Interpersonal skills	Teamwork	Working cooperatively with others to reach a common goal
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Technology	Selection	Choosing procedures, tools, or equipment including computers and related technologies
		Application	Demonstrating proper procedures for setting up and operating equipment
Create and construct a vessel that will float and bear weight (L.A.S. 2)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Creative thinking	Using imagination to generate new ideas
		Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative
		Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
	Interpersonal skills	Teamwork	Working cooperatively with others to reach a common goal
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Technology	Selection	Choosing procedures, tools, or equipment including computers and related technologies
		Application	Demonstrating proper procedures for setting up and operating equipment

Related Academic and Workplace Skills List

Task	Skill group	Subskill	Description
Unit 5: Career-Exploration Process			
Gather personal information (A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative
		Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
	Personal-management skills	Self-esteem	Developing self-confidence and maintaining a positive view of self
		Career awareness, development, and mobility	Assessing self accurately, setting personal goals, establishing and implementing a plan, and monitoring progress
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources or creating it, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
Gather general job information and identify occupational area of choice (A.S. 2)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative
		Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
	Personal-management skills	Self-esteem	Developing self-confidence and maintaining a positive view of self

Related Academic and Workplace Skills List

Task	Skill group	Subskill	Description
Unit 5: Career-Exploration Process (cont.)			
A.S. 2 (cont.)		Career awareness, development, and mobility	Assessing self accurately, setting personal goals, establishing and implementing a plan, and monitoring progress
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources or creating it, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
Gather specific job information (A.S. 3)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative
		Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
	Personal-management skills	Self-esteem	Developing self-confidence and maintaining a positive view of self
		Career awareness, development, and mobility	Assessing self accurately, setting personal goals, establishing and implementing a plan, and monitoring progress
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources or creating it, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
Make a career decision (A.S. 4)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative

Related Academic and Workplace Skills List

Task	Skill group	Subskill	Description
Unit 5: Career-Exploration Process (cont.)			
A.S. 4 (cont.)		Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
	Personal-management	Self-esteem	Developing self-confidence and maintaining a positive view of self
		Career awareness, development, and mobility	Assessing self accurately, setting personal goals, establishing and implementing a plan, and monitoring progress
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources or creating it, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
Develop a plan of action to meet career goal (A.S. 5)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative
		Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
	Personal-management skills	Self-esteem	Developing self-confidence and maintaining a positive view of self
		Career awareness, development, and mobility	Assessing self accurately, setting personal goals, establishing and implementing a plan, and monitoring progress
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources of creating it, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others

Related Academic and Workplace Skills List

Task	Skill group	Subskill	Description
Unit 6: Evaluating the Consequences of Using Technology			
Evaluate the consequences of your television-watching habits (A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Creative thinking	Using imagination to generate new ideas
		Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative
		Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
		Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources or creating it, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how social, organizational, and technological systems work and operate effectively
		Monitoring	Distinguishing trends, predicting impact of actions on system operations, diagnosing deviations in systems' performance, and correcting malfunctions
Evaluate the consequences of your family's present recycling habits (A.S. 2)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Creative thinking	Using imagination to generate new ideas
		Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative

Related Academic and Workplace Skills List

Task	Skill group	Subskill	Description
Unit 6: Evaluating the Consequences of Using Technology (cont.)			
A.S. 2 (cont.)		Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
		Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how social, organizational, and technological systems work and operate effectively
		Monitoring	Distinguishing trends, predicting impact of actions on system operations, diagnosing deviations in systems' performance, and correcting malfunctions
Collect a sample of the particulate matter in the air (L.A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Thinking skills	Creative thinking	Using imagination to generate new ideas
		Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative
		Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
		Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem

BEST COPY AVAILABLE

What Is Technology Education?
Unit 1

Suggested Activities

Instructional plan

Preparation

Plan your presentation.

- Review the student components presented for this unit in the student edition.
  - — Objective Sheet
  - — Information Sheet
  - — Assignment Sheet 1, "Profile the Technology Resources and Systems in Your State"
  - — Assignment Sheet 2, "Draw a Systems Model to Analyze an Industry, Business, or Company in Your Local Area"
  - — Assignment Sheet 3, "Explore the Interrelationship of the Functions of the Types of Technology Systems"
  - — Student Supplement 1, "Honda Overview"
- Review the teacher components presented for this unit in this teacher edition.
  - — Learning Activities Sheet
  - — Teacher Supplement 1, "Using the AIT Media Program"
  - — Optional Assignment Sheet 1, "AIT Media Questions for Discussion and Review"
  - — Optional Information Sheet 1, "Milestones of History"
  - — Optional Assignment Sheet 2, "Technology and Product Development"
  - — Optional Assignment Sheet 3, "Great Inventions: A Product of Human Creativity, Hard Work, and Technology Resources"
  - — Answers to Assignment Sheets
  - — Written Test
  - — Answers to Written Test
  - — Unit Evaluation Form

The **Learning Activities Sheet** is a step-by-step instruction sheet you may copy and distribute to your students to guide their individual study through the required components in the student edition (Objective Sheet, Information Sheet, Assignment Sheets, Student Supplements).

Note that Step 2 on this Learning Activities Sheet asks the student to obtain a copy of the questionnaire, "Questions for Discussion and Review," and Step 3 asks the student to watch an unnamed media presentation and complete the questions for discussion and review.

You may obtain and show the AIT media presentation designed to go with this unit. **Teacher Supplement 1, "Using the AIT Media Program,"** summarizes the content of this presentation (see the Suggested Supplemental Materials section below for ordering information).

Suggested Activities

If you select the AIT presentation, write the name of that media presentation on the blank line in the Learning Activities Sheet, or if you have selected another media presentation to use with your class, write in the title of that presentation.

If you use the AIT media presentation, you may use **Optional Assignment Sheet 1** in Step 3, which asks students to complete questions for discussion and review. If you use another media presentation, you should prepare your own questionnaire to be used with Step 3 on the Learning Activities Sheet and title it "Questions for Discussion and Review."

Optional Information Sheet 1, **"Milestones of History,"** is a time line presented in outline form; this time line outlines the cultural and technological eras of history.

Optional Assignment Sheet 2, **"Technology and Product Development"** and **Optional Assignment Sheet 3**, **"Great Inventions: A Product of Human Creativity, Hard Work, and Technology Resources"** are exercises you may use to have your students explore the inventions and inventors outlined in Optional Information Sheet 1.

- Modify the Learning Activities Sheet as needed to reflect your instructional plan. Copy and prepare the Learning Activity Sheet for distribution to your students.
- Copy and prepare the other teacher components you select to distribute to your students (Written Test, Unit Evaluation Form).
- Prepare the classroom by putting up posters and charts and displaying articles and other references related to the objectives of this unit.

Delivery and application Have students complete the steps in the Learning Activities Sheet, "What Is Technology Education?"

Evaluation

- Evaluate the assignment sheets. See the evaluation criteria listed at the top of each assignment sheet as well as the teacher page **Answers to Assignment Sheets**.
- Give the written test. See the teacher page **Written Test**.
- Evaluate the written test. See the teacher page **Answers to Written Test**.
- Compile written-test and assignment-sheet scores. See the teacher page **Unit Evaluation Form**.
- Reteach and retest as required.

Suggested Activities

Suggested resources

Resources used in developing this unit

Print media

- Fales, James F., Vincent F. Kuetemeyer, and Sharon A. Brusic. *Technology Today and Tomorrow.* Mission Hills, California: Glencoe Publishing Company, 1988.
- Hacker, Michael, and Robert Barden. *Living with Technology,* 2nd ed. Albany, New York: Delmar Publishers, Inc., 1993.
- Hacker, Michael, and Robert Barden. *Technology in Your World,* 2nd ed. Albany, New York: Delmar Publishers, Inc., 1992.
- Thode, Brad, and Terry Thode. *Technology.* Albany, New York: Delmar Publishers, Inc., 1994.

Suggested supplemental resource

- AIT media program, *Overview of Technology,* copyright 1990.

Available from:

Agency for Instructional Technology (AIT)
Box A
Bloomington, Indiana 47402

Phone: (800) 457-4509 or (812) 339-2203

What Is Technology Education?
Unit 1

Learning Activities Sheet

Put a checkmark in each blank as you complete each of the steps below.

_______ 1. **Read** Objective Sheet.

_______ 2. **Stop** Check with your instructor and obtain a copy of the questionnaire "Questions for Discussion and Review."

_______ 3. **Watch** Media presentation ______________________________

____

and

Complete "Questions for Discussion and Review."

_______ 4. **Study** Information Sheet, Objectives 1 through 8.

_______ 5. **Do** Assignment Sheet 1, "Profile the Technology Resources and Systems in Your State."

_______ 6. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 7. If the evaluation is not satisfactory, repeat Steps 4 and 5.

_______ 7. **Do** Assignment Sheet 2, "Draw a Systems Model to Analyze an Industry, Business, or Company in Your Local Area."

_______ 8. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 9. If the evaluation is not satisfactory, repeat Step 7.

_______ 9. **Read** Student Supplement 1, "Honda Overview."

_______ 10. **Do** Assignment Sheet 3, "Explore the Interrelationship of the Functions of the Types of Technology Systems."

_______ 11. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 12. If the evaluation is not satisfactory, repeat Step 10.

_______ 12. **Stop** Check with your instructor for any optional activities he or she may choose to assign.

Continue to back of this page.

Learning Activities Sheet

_______ 13. **Do** Optional activities listed below.

_______ 14. **Stop** Have your instructor evaluate the optional activities. If the evaluation is satisfactory, continue to Step 15. If the evaluation is not satisfactory, repeat Step 13 as your instructor directs.

_______ 15. **Take** Written Test.

_______ 16. **Stop** Have your instructor evaluate the completed written test. If the evaluation is satisfactory, proceed to the next learning activities sheet. If your evaluation is not satisfactory, ask your instructor for directions for reviewing the information in this unit.

Permission to duplicate this form is granted.

What Is Technology Education?
Unit 1

Teacher Supplement 1—Using the AIT Media Program

Program name

AIT media, "Overview of Technology"

Program summary

This media program examines what technology is, how it has evolved, and how it is used to meet human needs and solve common and uncommon problems. Opening with drummer Rick Allen of the rock band, Def Leppard. who lost his left arm in a car accident, the program shows him playing as well as ever. How does he do it? Historical footage of the building and subsequent restoration of the Statue of Liberty, work in old and new garment-industry factories, and developments in photography provide a backdrop to the definition of technology—"the application of knowledge and the use of resources to meet human needs and solve problems." A spin-off from the knowledge that created the moon buggy is a single joystick to control a disabled driver's van.

Resources such as materials, people, and tools have combined with knowledge to create and improve new technologies in construction; manufacturing; communication; and energy, power, and transportation. The rate of technological change is exponential; it is thought to be doubling every two to four years. The Rube Goldberg Competition carries technology to a humorous extreme—a pencil sharpener that makes use of at least 25 steps. The narrator introduces the systems model—input, process, output, and feedback—that underlies all technology. Students at an Odyssey of the Mind Competition demonstrate that problem solving can be both challenging and fun. A return to Def Leppard reveals that Rick Allen uses foot pedals linked to computers to play his drums. The program concludes by asking students how their generation will house and feed an overpopulated world.

Program objectives

The media program is designed to illustrate that

- technology is the application of knowledge and the use of resources to meet human needs and solve problems.
- there is currently an exponential increase of technology products because human knowledge is accumulating.

What Is Technology Education?
Unit 1

Optional Assignment Sheet 1—AIT Media Questions for Discussion and Review

Name ______________________ Date ____________

Evaluation criteria **Rating**

Directions have been followed. ______

Student responses are relevant and well thought out. ______

Overall rating ______

Evaluator's comments ______________________________

Exercise

Directions As you watch the AIT media presentation, answer each of the following questions in the space provided below each question.

Discussion/ review questions

1. What is the definition of the term *technology*?

2. What examples of problems and technological solutions are shown in the media presentation?

Optional Assignment Sheet 1

3. What, in addition to knowledge, are the types of resources required for technology?

4. Describe how technology has grown since the beginning of mankind. What were some examples of early developments?

5. What are the four stages in a technology systems model? Apply these terms to the pencil sharpener in the Rube Goldberg Competition.

6. What are the systems of technology?

7. What problems do you think people will have to solve in the future and how will your generation use technology to solve these problems?

Permission to duplicate this assignment is granted.

What Is Technology Education?
Unit 1

Optional Information Sheet 1—Milestones of History

1. **Historical eras**

The ages of history can be classified using many different types of classification systems. One classification system looks at the ways human society has been organized and classifies historical time into four cultural eras: (1) Nomadic Era, (2) Agricultural Era, (3) Industrial Era, and (4) Information Era.

Another type of classification system looks at the most technologically advanced materials people used for making most of their tools and products and classifies historical time into three technology ages: (1) Stone Age, (2) Bronze Age, and (3) Iron Age.

- **Cultural eras**

— **Nomadic Era** (2.5 million years ago; to 5000 BC)

During the Nomadic (hunting and gathering) Era, human society was based on the need to hunt animals and to gather food from wild plants. People lived in caves or some form of temporary structures. They traveled because they had to move to areas where hunting would be better.

— **Agricultural Era** (5000 BC to 1750 AD)

During the Agricultural Era, human society was based on the need to raise crops and livestock for food, clothing, energy, and transportation. Changes took place very slowly. Most people worked as farmers growing food. Much of the work was done by hand, and people made most of their own tools and clothing themselves. They bartered for materials they could not grow or make themselves. Education was handled by a master/apprentice system.

The trigger that allowed society to move from the Nomadic Era and into the Agricultural Era was the discovery and invention of the plow. With the invention of the plow, people could produce enough food and could store it for use in non-growing seasons or for travel to more distant areas.

— **Industrial Era** (1750 AD to present)

During the Industrial Era, human society has been based on the need to produce heavy manufacturing using machinery powered by mechanical sources of energy such as steam engines, electric dynamos, internal-combustion engines, and nuclear reactors. During this age, machines were invented that did work faster and easier than people could, and with assembly-line production, goods could be made in large quantities in factories. Many things were sold in stores.

With these new inventions, fewer and fewer people were needed to grow food. Handcrafted goods made locally became less important. People did not have to live close to their food supply. Cities grew. New forms of transportation (railroads, cars, and airplanes) allowed people to travel long distances. Education was based on training people in specific job skills.

Optional Information Sheet 1

Two important inventions were the triggers for change from the Agricultural Era to the Industrial Era—the lateen sail and the steam engine. The lateen sail allowed people to travel further at sea and visit new lands. This permitted trade to begin between distant countries. The invention of the steam engine was significant because, for the first time, a machine could do some of the work people would have had to have done previously by hand.

— **Post-Industrial Era (the Information Era)** (present and into the future)

We are presently moving out of the Industrial Era and into the Post-Industrial or Information Era. Many technology experts believe we have entered an era in which heavy industry, with its focus on iron and steel, will rapidly give way to a culture based on electronic communication and the use of synthetic materials.

Fewer workers are needed to make and grow necessities; trade markets are worldwide rather than local. More people are needed to process information; more people are needed to work in service jobs.

Everything around us changes at a very fast pace. Communication is instantaneous. Countries can modernize faster because of all the information that is available. Workers can expect to change jobs several times in a lifetime as technology changes change their work. Education is needed to help people adapt to the rapid changes they will experience in their lives.

The invention that triggered the change from the Industrial Era to the Information Era was the computer. The computer increased people's abilities to extend their thinking and decision-making abilities because it allowed them to deal more easily with large amounts of information.

- **Ages of technology**

— **Stone Age** (750,000 years ago; to about 4000 BC)

During this age, tools were made from stone and, later, bone, antler, and wood.

— **Bronze Age** (4000 BC to 1000 BC)

During this age, tools were made from copper and, later, bronze, an alloy of copper and tin.

— **Iron Age** (1000 BC to present)

Beginning about 1000 BC, most tools were made from wrought iron; beginning in the twelfth century, most tools were made from iron; then, during the middle of the nineteenth century, most tools were made from steel.

Optional Information Sheet 1

2. **Significant technological advances made throughout the historical eras**

- **Stone Age**
  - 750,000 to 15,000 years ago
    - ■ The use of fire
    - ■ The invention of various tools

      For hunting, stone spears and spear throwers, bows and arrows
      For domestic needs, mortars and pestles for grinding grains, bone sewing needles
  - 15,000 to 12,000 years ago
    - ■ The refinement of various tools

      For hunting, smaller, chipped-stone (flints) for arrowheads and spearheads
      For domestic needs, bone, antler, and wood tools; axes and adzes for shaping wood
  - 12,000 to 6,000 years ago
    - ■ For domestic needs, digging stick and wood hoe for gardening; pottery; spinning and weaving; house building
- **The Bronze Age**
  - 4000 BC
    - ■ The ox-drawn plow
    - ■ Copper and bronze metallurgy (smelting)
    - ■ Stone block and brick construction
  - 3500 BC—Writing
  - 3000 BC—The wheel
  - 1700 BC—Horse-drawn, two-wheel chariot
- **The Iron Age**
  - 1000 BC
    - ■ Wrought iron
    - ■ Post and lintel construction
    - ■ Stone arch
  - 800 AD—Gunpowder
  - 1100 AD
    - ■ Horseshoe
    - ■ Saddle
    - ■ Stirrup

Optional Information Sheet 1

- 1455 AD
    - Moveable-type printing press
- 1500 AD
    - Spanish galleon

- **The Industrial Era**

1709—Smelting iron in coal-fired blast furnace
1712—Steam engine

1801—Jacquard loom
1807—Steamboat
1825—Steam railway
1831—McCormick's reaper; discovery of electromagnetic induction
1837—Telegraph
1846—Sewing machine
1847—Bessemer process of making steel
1859—First oil well
1860—Internal-combustion engine
1862—First automobile
1876—Telephone
1879—Incandescent lamp
1882—Steam turbine
1884—DC electric motor
1888—AC electric motor
1896—Radio
1897—Diesel engine

1903—Airplane
1913—Automobile assembly line
1927—Nylon
1930—Jet engine
1930s—Television
1945—Atomic bomb
1946—Computer
1950s—LASER and MASER
1957—First space flight
1969—First moon landing
1971—Microprocessor
1976—Apple computer
1977—Space shuttle
1981—Silicon computer chip
1984—Compact-disc (CD) player
1985—CD-ROM (compact-disc read-only memory)

Optional Information Sheet 1

3. Current trends in technology

- **Communication**
  - Electronic publishing via the Internet and CD-ROM
  - At-home computer stations allowing communication via computer modems, the Internet, FAX machines, and Read-Write CDs
  - Video-conferencing
- **Manufacturing**
  - Superceramics (materials made from abundant natural resources such as sand and clay)
  - Plastics (petroleum-based materials)
  - Better, less-expensive, and cleaner methods of processing materials such as steel, glass, brick, wood, and wood by-products
  - Robotics (computer-controlled machinery)
- **Construction**
  - Modular and pre-fabricated construction
  - Energy-efficient construction
  - "Smart buildings" (houses and offices with computer-controlled, electronically activated appliances, lighting, heating, cooling, and plumbing)
  - Computer-aided design (CAD)
  - Laser technology
  - Ultra-light metals
  - Plastics
  - Construction in space
- **Energy, power, and transportation**
  - Solar power (stores heat from the sun or converts sunlight to electrical energy)
  - Wind power (converts the energy in wind to electrical energy)
  - Geothermal power (converts the heat from underground sources of steam to electrical energy)
  - Electric-battery-operated automobiles
  - Alternative fuels for automobiles
  - Light-weight yet strong materials for constructing transportation vehicles
  - On-board computers and microprocessors

Permission to duplicate this information is granted.

What Is Technology Education?
Unit 1

Optional Assignment Sheet 2—Technology and Product Development

Name ______________________________ Date ____________________

Evaluation criteria	**Rating**
Directions have been followed.	______
Report completed in Part A is relevant and well thought out.	______
Evolution board completed in Part B is neat, attractive, and well organized visually.	______
Overall rating	______

Evaluator's comments ______________________________

____

____

Introduction

Innovations may simply be improvements on existing products, or they may combine existing products in new ways. Read "The History of Blue Jeans" on the following pages to see how technological changes in existing products ultimately brought about the product of clothing we know today as *blue jeans*.

Exercise

Part A **Research the evolution of a product.**

Directions

Talk to your teachers, parents, or grandparents about products (some suggested topics are given in the list on the next page) they have used but have since become outmoded. After these discussions, select one product you want to do more formal research on.

During your formal research, consider the product itself, the needs the product filled, and how the product filled these needs. Also, consider the products that preceded the one you are researching and those that replaced it; what technologies do these products have in common; how are they different; and in what ways do the new products fill the purpose better than the old.

Then, as your instructor directs, prepare a written report or computer presentation. Use "The History of Blue Jeans" as a model for your presentation. In your presentation, explain how the product you selected combined new technologies with old to perform its function better and how it too was replaced by a product that combined new technologies with old.

Optional Assignment Sheet 2

Suggested topics

Vinyl LP records
Eight-track tapes
Lead-based paints
Mechanical adding machines

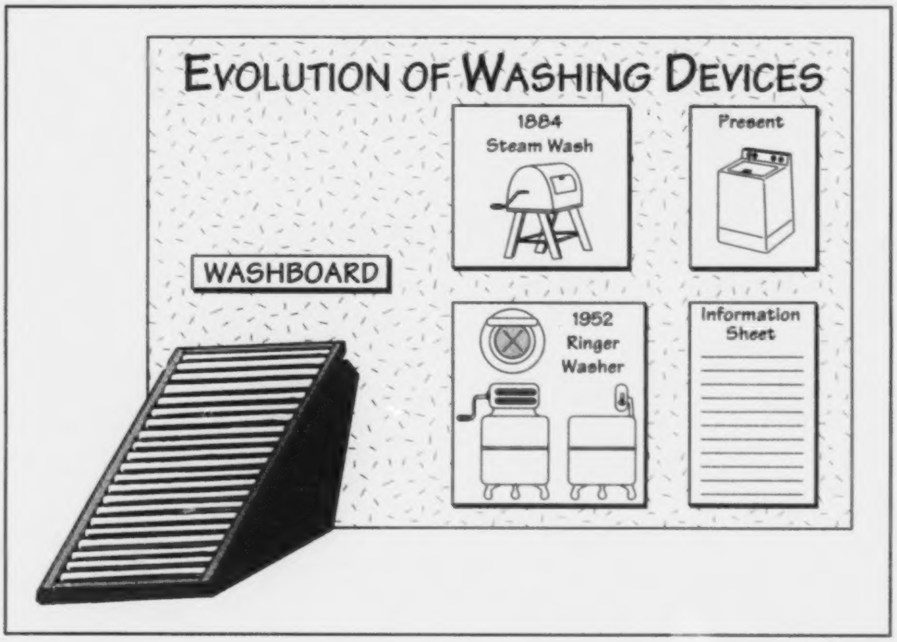
Part B **Complete an evolution board.**

Directions See the sample evolution board "Evolution of Washing Devices" provided below, and then, prepare an evolution board for the product you did your research presentation on.

In your evolution board, you must show at least four stages in the development of the product—four stages showing how the device has changed since the product was first invented. Note that, in the sample, one of the stages of development is shown by an actual object (the washboard); stages may be shown by actual objects, models of the objects, or drawings.

As a part of your evolution board, you will also display an information sheet stating who invented the device, the various dates for each of its stages, the type of technology it represents, and the need or want the device meets.

Sample of an evolution board



Optional Assignment Sheet 2

The History of Blue Jeans

Introduction

Odds are, you have a pair of blue jeans in your closet, and those blue jeans might well have rivets at the corners of the pockets. They might also have belt loops and a pattern of stitching on the back pockets that is distinctive to the particular brand. Those blue jeans probably aren't the first thing that come to mind when you think of technology—especially if you have a computer sitting on your desk or a Nintendo connected to your television. But when you know a little bit more about their history, you'll see that blue jeans are a good example of how technical innovations can create new products to better fill human needs.

The story goes . . .

The story goes that a would-be gold-seeker name Levi Strauss arrived in San Francisco, California, in 1853, carrying a bundle of yard goods that he hoped to sell for a grubstake. As he walked along the dock, an earlier arrival asked what he was carrying. When Levi told him that the bundle was heavy canvas for tents and awnings, the man said it was too bad he hadn't brought pants. The hard labor of mining gold wore pants out so quickly that they were in great demand in the goldfields. At that, Levi took the man to the nearest tailor and had the tailor make two pairs of pants from the canvas—one for himself and one for his newfound friend. From those two pairs of pants, the entire blue jeans industry was born.

The truth is . . .

It's a nice story, but the truth is less dramatic. Riveted blue jeans were actually invented in 1870 by a Reno, Nevada, tailor named Jacob Davis. A woman asked Jacob to make a pair of pants for her husband, a log cutter. The pants had to be sturdy, she said, because her husband's hard work quickly wore out his clothing, especially the seams of his pockets.

Jacob set about making the pants from the heaviest fabric he had, a white duck canvas that he used for horse blankets. When he finished the pants, it occurred to him that the rivets he used on horse blankets might keep the pocket seams from ripping out. So, he hammered an iron rivet into each corner of the pockets. After the woman took the pants, Jacob thought no more about them. Soon, however, word of his wonderful riveted pants spread and his business grew. When he could not get the cotton duck in any color other than off white, he also started making pants of blue denim.

Because Davis could not afford to apply for a patent on his riveted clothing, he approached Levi Strauss & Co., the San Francisco dry-goods wholesaler from whom he purchased his duck and denim fabric. They formed a partnership and began manufacturing the pants, paying women by the pair to sew them together from pre-cut pieces. At first the women sewed the pants by hand at home. They could sew about three pairs of pants a day. Soon the company employed women to work at sixty sewing machines in a steam-powered factory. In the factory, one employee could sew about five pairs of pants a day.

Optional Assignment Sheet 2

The company used copper rivets that didn't rust like the iron ones, and orange thread to match the rivets. At first, the pants had suspender buttons instead of belt loops. Belt loops were added in the 1930s. At that time, Levi Strauss began covering the rivets on the back pockets because customers complained that they scratched saddles, furniture, and cars. Eventually, they quit using rivets on the back pockets altogether. And the distinctive stitching on the back pockets? Some early blue jeans had blanket linings for cold weather. Historians think the back-pocket stitching originated to hold the lining in place in the pockets. Before long, the patterns were associated with brands. When the lining was abandoned, the stitching remained.

Conclusion Working people such as miners, loggers, farmers, and ranchers liked the durable pants. They bought more and more of them, and other manufacturers started making similar sturdy duck and denim clothing. Today's immense blue-jeans industry with all of its different styles and brands and manufacturers may be America's biggest contribution to the world of fashion. And it all started when a clever tailor made the most of the materials he had at hand and the methods he knew best to turn horse blankets into clothes for working people.

Permission to duplicate this assignment is granted.

What Is Technology Education?
Unit 1

Optional Assignment Sheet 3—Great Inventions: A Product of Human Creativity, Hard Work, and Technology Resources

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	______
Student responses on fact sheets are relevant and well thought out.	______
Fact sheets are neat, attractive, and well organized visually.	______
Overall rating	______

Evaluator's comments ______________________________

____

____

Introduction

No matter how sophisticated the products of technology become, they were each often a product of human creativity in using present technology resources combined with some plain, hard work. In Optional Information Sheet 1, you reviewed some of the great inventions of the Industrial Era. In this exercise, you will explore the life of one of the inventors of one of those great inventions to see how he or she combined creativity and hard work and technology resources to produce one of those great inventions.

Exercise

Directions

Your instructor will conduct a class discussion on the great inventions of the Industrial Era, which are presented in Optional Information Sheet 1. As a part of this discussion, your class will make a list of the famous inventors of the Industrial Era. Then, your instructor will assign you one of those inventors to research to complete the two fact sheets that follow.

In Fact Sheet 1, place photocopies of the requested pictures in the spaces provided, or if you cannot find the specific pictures requested, substitute sketches or copies of other appropriate pictures. Label the pictures as indicated on the fact sheet.

After you have completed Fact Sheet 1, select your inventor's most significant invention and research the development of that invention. By completing Fact Sheet 2, you should develop a better understanding of how great inventors have used the technology resources at hand to create their great inventions.

Permission to duplicate this assignment is granted.

Optional Assignment Sheet 3

Fact Sheet 1: Great Inventors of the Industrial Era

Name of inventor: ______________________________

Dates of birth and death: ______________________________

Place of birth: ______________________________

Citizenship: ______________________________

Education: ______________________________

Three significant inventions or accomplishments:

1. ______________________________
____
2. ______________________________
____
3. ______________________________
____

Portrait of inventor

(Label below.)

Important biographical facts: ______________________________

____

Most significant invention

(Label below.)

____

____

____

____

____

____

____

____

____

____

____

Optional Assignment Sheet 3

Fact Sheet 2: Great Inventions of the Industrial Era

Name of invention: ____________________ Name of inventor: ____________________

Date invented: ____________________ Place invented: ____________________

Resources used:

1. People in addition to inventor: ____________________
2. Information: ____________________
3. Materials: ____________________
4. Tools and machines: ____________________
5. Energy: ____________________
6. Capital: ____________________
7. Time: ____________________

What Is Technology Education?
Unit 1

Answers to Assignment Sheets

Answers to required assignment sheets in student edition

Assignment Sheet 1—Answers will vary. Student performance should be evaluated according to the criteria listed on the assignment sheet.

Assignment Sheet 2—Answers will vary. Student performance should be evaluated according to the criteria listed on the assignment sheet.

Assignment Sheet 3—Answers will vary. Student performance should be evaluated according to the criteria listed on the assignment sheet.

Answers to optional assignment sheets in teacher edition

Assignment Sheet 1

1. The application of knowledge and the use of resources to meet human needs and solve problems
2. The deterioration of the Statue of Liberty—the restoration of the statue with new materials and improved structural design; long days in poor factory conditions—improved machinery and automation; sitting still for long periods of time for a photograph—instant photography and high-speed film; driving a vehicle without the use of legs—joystick hand controls; Def Leppard's drummer, Rick Allen, with only one arm—now playing drums using a computer linked to a foot pedal
3. Materials, people, tools
4. Technology developed very slowy in the beginning with simple tools for hunting, making things, and growing food. Then, the pace of technology became exponential, doubling every two to four years.
5. Input, process, output, feedback

   Input—broken pencil; process—sharpening; output—sharpened pencil; feedback—how well the pencil writes, or being awarded first prize
6. Communication; construction; manufacturing; and energy, power, and transportation
7. Answers will vary.

Assignment Sheet 2—Answers will vary. Student performance should be evaluated according to the criteria listed on the assignment sheet.

Assignment Sheet 3—Answers will vary. Student performance should be evaluated according to the criteria listed on the assignment sheet.

What Is Technology Education?
Unit 1

Written Test

Name ______________________________ Score ______________

1. Define the term *technology education*. Write your answer on the blanks provided beside the term below.

Technology education ______________________________

____

____

____

2. Define the term *technology*. Write your answer on the blanks provided beside the term below.

Technology ______________________________

____

____

____

3. Define the term *system*. Write your answer on the blanks provided beside the term below.

System ______________________________

____

____

____

4. Define the term *technology system*. Write your answer on the blanks provided beside the term below.

Technology system ______________________________

____

____

____

Written Test

5. Match types of technology systems to their correct definitions. Write the numbers on the blanks provided.

_______ a. System in which information is exchanged between individuals or machines through a common system of signs, symbols, or behavior

_______ b. System in which materials and processes are used to produce a product that will be used elsewhere

_______ c. System in which manufactured goods and materials are used to build a structure on site

_______ d. System in which energy is converted into mechanical, fluid, or electrical power to do work

1. Communication system
2. Construction system
3. Manufacturing system
4. Energy, power, and transportation system

6. Define the stages in a basic technology systems model. Write your answers on the blanks provided beside each of the terms below.

   a. **Stage 1: Input** ____

   b. **Stage 2: Process** ____

   c. **Stage 3: Output** ____

   d. **Stage 4: Feedback** ____

7. List the classifications of the resources used in the various types of technology systems. Write your answers on the blanks provided below.

   a. ____
   b. ____
   c. ____
   d. ____
   e. ____
   f. ____
   g. ____

Written Test

8. Discuss the interrelationship of the functions of the types of technology systems. Write your answers on the blanks provided beside each of the terms below.

   a. **Communication** ______________________________

   b. **Construction** ______________________________

   c. **Manufacturing** ______________________________

   d. **Energy, power, and transportation** ______________________________

Permission to duplicate this test is granted.

What Is Technology Education?
Unit 1

Answers to Written Test

1. A hands-on, laboratory-based educational program that allows students to use problem-solving methods to explore the various systems of technology and the educational and career opportunities available in each system

2. The application of knowledge and the use of resources to meet human needs and solve problems

3. Group of people, procedures, equipment, and resources that function together to produce desired results

4. A group of technologies used in combination to deliver products or services that meet demands

5.
   a. 1
   b. 3
   c. 2
   d. 4

6.
   a. The means by which or the point at which something is put into a system
   b. A series of actions or operations occurring in a system
   c. Something produced by a system
   d. The return to the input stage with evaluative or corrective information about the system process and output

7. Answers may appear in any order.

- People
- Information
- Materials
- Tools and machines
- Energy
- Capital
- Time

8.
   a. Provides the means for the exchange of information required between manufacturing plants; construction sites; and energy, power, and transportation industries

   b. Builds structures to house manufacturing and communication enterprises; to produce, store, and transmit power; and to transport materials and products

   c. Produces products and processes used in communication; construction; and energy, power, and transportation

   d. Produces, stores, and transmits power used in manufacturing, construction, and communication; moves materials and products used by manufacturing, construction, and communication

What Is Technology Education?
Unit 1

Unit Evaluation Form

Student name ______________________ Unit rating __________

Assignment-sheet ratings

Assignment Sheet 1—Profile the Technology Resources and Systems in Your State Rating ______

Comments: ______________________

____

Assignment Sheet 2—Draw a Systems Model to Analyze an Industry, Business, or Company in Your Local Area Rating ______

Comments: ______________________

____

Assignment Sheet 3—Explore the Interrelationship of the Functions of the Types of Technology Systems Rating ______

Comments: ______________________

____

List optional assignments and ratings

Continue to back of this page.

Unit Evaluation Form

Written-test scores

Pretest ______________ Posttest ______________ Other ______________

Comments: ____

____

Teacher signature ______________________________ Date ______________

Student signature ______________________________ Date ______________

Permission to duplicate this form is granted.

Basic Laboratory Safety
Unit 2

Suggested Activities

Instructional plan

Preparation Plan your presentation.

- Review the student components presented for this unit in the student edition.

  - Objective Sheet
  - Information Sheet
  - Assignment Sheet 1, "Interpret Portable Fire-Extinguisher Symbols"
  - Student Supplement 1, "Guidelines for Using Portable Fire Extinguishers"
  - Student Supplement 2, "Extinguisher Markings for Extinguishers Suitable for Use on Class A, B, and C Fires"
  - Student Supplement 3, "Extinguisher Markings Indicating Extinguishers Unsuitable for Use on Class A, B, or C Fires"
  - Assignment Sheet 2, "Determine Correct Laboratory Safety Practices"
  - Assignment Sheet 3, "Identify Safety Practices Followed in Your Technology Education Laboratory"

- Review the teacher components presented for this unit in this teacher edition.

  - Learning Activities Sheet
  - Optional Assignment Sheet 1, "Complete a Student Safety Pledge and a Parent/Guardian Consent Form"
  - Answers to Assignment Sheets
  - Written Test
  - Answers to Written Test
  - Unit Evaluation Form

  The **Learning Activities Sheet** is a step-by-step instruction sheet you may copy and distribute to your students to guide their individual study through the required components in the student edition (Objective Sheet, Information Sheet, Assignment Sheets, Student Supplements).

  Optional Assignment Sheet 1, "Complete a Student Safety Pledge and a Parent/Guardian Consent Form," is an acitivty you may want your students to take home and complete so that you will have communicated to the student and to his or her parent/guardian the importance of safety in the technology education laboratory. These completed forms should be filed with each student's class records.

- Modify the Learning Activities Sheet as needed to reflect your instructional plan. Copy and prepare the Learning Activity Sheet for distribution to your students.

Suggested Activities

- Copy and prepare the teacher components you select to distribute to your students (Written Test, Unit Evaluation Form).
- Prepare the classroom by putting up posters and charts and displaying articles and other references related to the objectives of this unit.

Delivery and application

Have students complete the steps in the Learning Activities Sheet, "Basic Laboratory Safety."

Evaluation

- Evaluate the assignment sheets. See the evaluation criteria listed at the top of each assignment sheet as well as the teacher page **Answers to Assignment Sheets**.
- Give the written test. See the teacher page **Written Test**.
- Evaluate the written test. See the teacher page **Answers to Written Test**.
- Compile written-test and assignment-sheet scores. See the teacher page **Unit Evaluation Form**.
- Reteach and retest as required.

Suggested resources

Resources used in developing this unit

Print media

- *Fire Service First Responder*, 1st ed. Stillwater, Oklahoma: International Fire Service Training Association/Fire Protection Publications, 1987.
- Individualized Cooperative Education. Stillwater, Oklahoma: Oklahoma Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1990.

Suggested supplemental resources

Nonprint media

- The R.E.A.C.T. series of first-aid and safety color videos is an MTI release produced by Charles S. MacCrone Productions, Inc., but is available in ½-inch VHS format from Coronet Films, 65 E. South Water Street, Chicago, Illinois 60601; phone 1-800-621-2131. Titles in this series are listed and described below.

  — *Accident Prevention and Safety*, 13 min., copyright 1984.

  In this video, a machine-shop foreman and a worker review the machine safety precautions. Home safety hints for accident prevention are also outlined.

- *Slips, Trips, and Falls*, ½-inch VHS, color, 10 min., copyright 1983, Coronet Films, produced by Film Communicators.

  This video presents a humorous safety program narrated with Irish humor by Murphy, creator of "Murphy's Law"—which states that if anything can go wrong, it will.

Basic Laboratory Safety
Unit 2

Learning Activities Sheet

Put a checkmark in each blank as you complete each of the steps below.

_______ 1. **Read** Objective Sheet.

_______ 2. **Study** Information Sheet, Objectives 1 through 11.

_______ 3. **Read** Student Supplements 1 through 3.

_______ 4. **Do** Assignment Sheet 1, "Interpret Portable Fire-Extinguisher Symbols."

_______ 5. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 6. If the evaluation is not satisfactory, repeat Step 4.

_______ 6. **Do** Assignment Sheet 2, "Determine Correct Laboratory Safety Practices."

_______ 7. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 8. If the evaluation is not satisfactory, repeat Step 6.

_______ 8. **Do** Assignment Sheet 3, "Identify Safety Practices Followed in Your Technology Education Laboratory."

_______ 9. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 10. If the evaluation is not satisfactory, repeat Step 8.

_______ 10. **Stop** Check with your instructor for any optional activities he or she may choose to assign.

_______ 11. **Do** Optional activities listed below.

____

____

____

____

____

____

____

Continue to back of this page.

Learning Activities Sheet

_______ 12. **Stop** Have your instructor evaluate the optional activities. If the evaluation is satisfactory, continue to Step 13. If the evaluation is not satisfactory, repeat Step 11 as your instructor directs.

_______ 13. **Take** Written Test.

_______ 14. **Stop** Have your instructor evaluate the completed written test. If the evaluation is satisfactory, proceed to the next learning activities sheet. If your evaluation is not satisfactory, ask your instructor for directions for reviewing the information in this unit.

Permission to duplicate this form is granted.

Basic Laboratory Safety
Unit 2

Optional Assignment Sheet 1—Complete a Student Safety Pledge and a Parent/Guardian Consent Form

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	______
Forms are completely filled out.	______
Overall rating	______

Evaluator's comments ____

____

____

Introduction

It is important that both you and your parent/guardian understand the responsibilities you will be accepting when you are allowed to operate equipment in the technology education laboratory—you will be responsible for keeping yourself and your classmates safe from accidents and for preventing damage to the equipment you will be using in the laboratory.

Exercise

Directions

To literally bring the importance of your responsibilities home to you and your parent/guardian, (1) you need to sign and date the student safety pledge on the next page in front of your parent/guardian, and then, (2) have your parent/guardian sign and date the parent/guardian consent form.

Optional Assignment Sheet 1

Student Safety Pledge

To prevent harm to myself or others, and to keep from damaging equipment in the technology lab, I will obey this safety pledge:

1. I will follow all safety rules in the technology lab.
2. I will never use a machine unless I have learned how to use it, passed the safety test, and received my instructor's permission.
3. I will report any accident or injury to my instructor immediately.

______________________________ ____________
Student's signature Date

Parent/Guardian Consent Form

I hereby give my consent to allow my son or daughter to operate all machines and equipment necessary to carry out the requirements of the course in which he or she is enrolled.

______________________________ ____________
Parent's/guardian's signature Date

Parent/guardian may visit the technology lab to inspect the machines and see them in operation.

Permission to duplicate this assignment is granted.

Basic Laboratory Safety
Unit 2

Answers to Assignment Sheets

Answers to required assignment sheets in student edition

Assignment Sheet 1—Student performance should be evaluated according to the criteria listed on the assignment sheet. Content of each item in the exercise may be evaluated using the following suggestions as guides.

1
    a. 6
    b. 2
    c. 4
    d. 1
    e. 5
    f. 3

2.
    a. B; red
    b. A; green
    c. D; yellow
    d. C; blue

3.
    a. Pull the pin.
    b. Aim the nozzle at the base of the fire.
    c. Squeeze the handle.
    d. Sweep the nozzle.

Assignment Sheet 2—Student performance should be evaluated according to the criteria listed on the assignment sheet. Content of each item in the exercise may be evaluated using the following suggestions as guides.

Part A

1. b
2. a
3. d
4. d
5. d
6. d
7. b
8. c
9. c
10. c
11. c
12. c
13. d
14. d
15. d
16. b
17. a
18. c
19. c
20. a
21. a
22. b
23. d
24. b
25. c

Part B

Student should have listed any six of the following violations.

- Do not work in a laboratory without the supervision of your instructor.
- Do not use electrical equipment with worn or frayed electrical cords.
- Immediately report to your instructor defective equipment and worn or frayed electrical cords.
- Do not use electrical equipment near water.
- Unplug electrical equipment before cleaning, repairing, or changing accessories.
- Always wear eye protection while drilling.
- Store tools and accessories safely in suitable storage containers or areas.
- Immediately tag and report to your instructor any defective power tools or machines.

Answers to Assignment Sheets

Assignment Sheet 3—Answers will vary. Student performance should be evaluated according to the criteria listed on the assignment sheet.

Answers to optional assignment sheet in teacher edition

Assignment Sheet 1—Answers will vary. Student performance should be evaluated according to the criteria listed on the assignment sheet.

Basic Laboratory Safety
Unit 2

Written Test

Name ______________________________ Score ______________

1. Match to their correct definitions terms associated with laboratory safety. Write the numbers on the blanks provided.

_______ a. Potential source of danger

_______ b. Failure to think before one acts; failure to pay attention

_______ c. Suddenly occurring, unintentional event that causes injury or property damage

_______ d. Freedom from danger, risk, or injury

_______ e. Capable of bursting into flames at temperatures below 100°F

_______ f. Capable of being easily ignited and burning quickly at temperatures below 100°F

_______ g. To put out a fire; to cause to cease burning

_______ h. Any cancer-causing, corrosive, toxic, irritant, sensitizer, or material that has or has the potential for damaging effects on specific body organs

_______ i. Electrical connection to an object that conducts electrical current to the earth

1. Accident
2. Carelessness
3. Combustible
4. Safety
5. Hazard
6. Flammable
7. Hazardous material
8. Extinguish
9. Ground

2. State applications for the colors used in the federal safety color code. Read each of the following scenarios, and then on the blank line below each scenario, state the correct color code for the situation described.

   a. A fire ignites when a tank of fuel spills. You need to find a fire extinguisher quickly. What color will mark the location of the fire extinguisher?

   ____

   b. A piece of equipment in your lab is going to be repaired. Your instructor asks you to get a warning tag from the tool room to put on the equipment. What color of tag should you look for?

   ____

c. You are about to push a loaded dolly into the laboratory. What color of lines indicate the traffic-flow paths you should follow?

d. A classmate has splashed battery acid in her eyes and asks you to find the eye-wash station. What color will mark the location of the eye-wash station?

e. You have mopped up an oil spill and want to properly dispose of the rags you used. What color of waste container should you look for?

3. Correct false statements about general laboratory safety rules. Write an "F" on the blank before each false statement, and then, correct each false statement on the lines provided.

______ a. Do not work in the laboratory without the supervision of your instructor.

______ b. Know the correct area code for your area; make sure that it is posted near the telephone.

______ c. Be alert for dangers and hazards.

______ d. Conduct yourself in a safe manner; participate in horseplay only during breaks.

______ e. Be familiar with the location of fire-fighting and first-aid equipment.

______ f. Be aware of where others are in the lab and of what they are doing.

Written Test

______ g. Wear protective clothing and equipment as appropriate.

______ h. Use and store potentially hazardous materials and products strictly according to your instructor's instructions and cautions.

______ i. Do not operate equipment if you are over-tired or ill.

______ j. Follow all safety guidelines set by your instructor.

______ k. Report all hazards to your classmates.

______ l. Think safety and security for yourself and for the other students in your class.

______ m. Report all accidents to your instructor—no matter how minor the accident may seem.

______ n. Stay in your assigned area of the lab.

Written Test

4. Complete guidelines for maintaining a safe work area. Write the complete guideline that goes with each phrase below.

   a. Arrangement of equipment

   b. Storage of materials and supplies

   c. Storage of tools and accessories

   d. Work area

   e. Combustible materials

   f. Housekeeping supplies

g. Close your work area

5. Correct false statements about guidelines for dressing safely in the laboratory. Write an "F" on the blank before each false statement, and then, correct each false statement on the lines provided.

_______ a. Pull back long hair or wear hair spray or a hat.

_______ b. Wear well-fitting, comfortable, laced work shoes, and tie laces securely.

_______ c. While working on equipment, remove expensive jewelry that could drop into or get caught in the equipment.

_______ d. Wear close-fitting clothing appropriate for the work being done.

_______ e. Wear protective clothing and equipment as appropriate.

_______ f. Do not carry tools or sharp objects in your pockets.

Written Test

6. List four guidelines for preventing slips, trips, and falls. Write your answers on the blanks provided.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

7. List five guidelines for preventing electrical shock. Write your answers on the blanks provided.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

8. List six guidelines for preventing fire and fire spread. Write your answers on the blanks provided.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

   f. ______________________________

9. Complete guidelines for using flammable materials and toxic substances. On the blanks provided, write the complete guideline that goes with each word or phrase below.

   a. Label directions

   ____

   ____

   ____

   b. Fumes

   ____

   ____

c. Storage

d. Amount needed for the job

e. Clothing

f. Intended purposes

g. Clothing that catches on fire

h. Fire or flame

i. Engine that is running

j. Fuel leak

10. Complete general guidelines for using laboratory tools and power equipment. On the blanks provided, write the complete guideline that goes with each word or phrase below.

    a. Instructor's approval

    b. Training

    c. Safety rules and operating instructions

    d. Working order

Written Test

e. Storage

f. Guards and safety devices

g. Defective power tools or machines

h. Turning off power tools and machines

i. Correct tool

j. Compressed air

k. Lean

l. Throw

____

____

____

m. Not using a piece of equipment

____

____

____

11. List in order the general steps for handling any emergency situation. Write your answers on the blanks provided below.

a. Step 1: ________________________________

b. Step 2: ________________________________

c. Step 3: ________________________________

d. Step 4: ________________________________

Permission to duplicate this test is granted.

Basic Laboratory Safety
Unit 2

Answers to Written Test

1. a. 5
   b. 2
   c. 1
   d. 4
   e. 3
   f. 6
   g. 8
   h. 7
   i. 9

2. a. Federal safety red
   b. Federal safety blue or federal safety yellow
   c. Federal safety black and white
   d. Federal safety green
   e. Federal safety yellow

3. b. Know the correct ***emergency telephone numbers*** for your area; make sure that **they are** posted near the telephone.
   d. Conduct yourself in a safe manner; ***do not*** participate in horseplay ***in the laboratory***.
   h. Use and store potentially hazardous materials and products strictly according to ***the label*** instructions and cautions.
   k. Report all hazards to your ***instructor***.

4. a. Arrange equipment to allow safe working practices and ease of cleaning.
   b. Store materials and supplies safely in their proper places.
   c. Store tools and accessories safely in suitable storage containers or areas.
   d. Keep the work area organized and clear of debris and other hazards.
   e. Dispose of combustible materials properly.
   f. Keep enough brooms, brushes, waste containers, and housekeeping supplies on hand to keep the work area clean.
   g. Close your work area at the end of each class period by clearing away scrap materials and replacing tools and materials in their proper storage areas.

5. a. Confine long hair before using power equipment or working around any machinery with moving parts.
   c. Remove rings and other jewelry before entering the lab.

6. Answer should include any four of the following.

   - Wipe up spills immediately.
   - Post warning signs when floors are wet.
   - Report any tripping hazard.
   - Do not leave equipment, materials, or other obstacles in traffic areas, before doors and exits, or in any other area where people may trip over them.
   - Do not stretch extension cords across traffic areas.

Answers to Written Test

7. Answer should include any five of the following.

- Be sure that an electrical outlet is grounded before plugging in an electrical cord.
- Do not use electrical equipment with worn or frayed electrical cords.
- Immediately report to your instructor all defective equipment and worn or frayed electrical cords.
- Avoid using extension cords and overloading outlets.
- Do not handle electrical equipment when your hands are wet, and do not use electrical equipment near water.
- Unplug electrical equipment before cleaning, repairing, or changing accessories.
- Know the location of the main power switch in case electrical power must be turned off in an emergency.

8. Answer should include any six of the following.

- Do not let trash accumulate in storage areas.
- Store flammable and combustible materials only in approved containers and cabinets.
- Keep fire doors closed, unlocked, and unblocked.
- Know the locations of fire extinguishers, fire alarms, and emergency exits.
- Do not block aisles or accesses to fire alarms, extinguishers, or emergency exits.
- Notify your instructor immediately if a fire—no matter how small—is detected.
- Know how to use fire extinguishers.

9. a. Carefully read and follow the label directions for flammable liquids and toxic substances.
b. Avoid breathing fumes from flammable liquids and toxic substances; use only in well-ventilated area.
c. Be sure that flammable liquids and toxic substances are properly marked and stored.
d. Have at the work area only the amount of flammable liquid or toxic substance needed for the job being done.
e. Immediately change clothing on which flammable materials or toxic substances have been spilled.
f. Use flammable liquids and toxic substances only for their intended purposes.
g. If your hair or clothing catches fire, do not run; stop, drop, and roll to smother the fire, using a blanket if available.
h. Do not use flammable materials near a fire or flame.
i. Never put fuel into a fuel tank when the engine is running.
j. Do not operate equipment with a fuel leak.

10. a. Obtain your instructor's approval before operating any power equipment.
b. Operate a tool or machine only after receiving training on how to use it properly and safely.
c. Obey all safety rules and operating instructions provided by the tool or machine manufacturer, plus any additional ones required in your lab.
d. Keep tools and machines clean and in good working order.
e. Properly store tools and machines when not in use.
f. Keep guards and safety devices in place on all tools and machines.
g. Immediately tag and report to your instructor any defective tools or machines.
h. Turn off power tools and machines when not in use.
i. Use the correct tool for the job to be done.
j. Never use compressed air to clean yourself or your clothing; do not direct compressed air toward another person.
k. Do not lean on any of the machines in the lab.
l. Never throw tools or materials in the lab.
m. If you are not going to use a piece of equipment, leave it alone.

Answers to Written Test

11. a. Determine the type of emergency.
    b. Notify the appropriate medical or law-enforcement authority.
    c. Notify your instructor.
    d. Provide basic first aid if you have been properly trained, or seek assistance from others until the proper authorities arrive.

Basic Laboratory Safety
Unit 2

Unit Evaluation Form

Student name ______________________________ Unit rating ______________

Assignment-sheet ratings

Assignment Sheet 1—Interpret Portable Fire-Extinguisher Symbols Rating ________

Comments: ____

____

____

Assignment Sheet 2—Determine Correct Laboratory Safety Practices Rating ________

Comments: ____

____

____

Assignment Sheet 3—Identify Safety Practices Followed in Your Technology Education Laboratory Rating ________

Comments: ____

____

____

List optional assignments and ratings.

Continue to back of this page.

Unit Evaluation Form

Written-test scores

Pretest ____________ Posttest ____________ Other ____________

Comments: ____

____

____

Teacher signature ______________________________ Date ______________

Student signature ______________________________ Date ______________

Permission to duplicate this form is granted.

Measuring and Related Math
Unit 3

Suggested Activities

Instructional plan

Preparation Plan your presentation.

- Review the student components presented for this unit in the student edition.
  - Objective Sheet
  - Information Sheet
  - Assignment Sheet 1, "Add Whole Numbers"
  - Assignment Sheet 2, "Subtract Whole Numbers"
  - Assignment Sheet 3, "Multiply Whole Numbers"
  - Student Supplement 1, "Multiplication Table"
  - Assignment Sheet 4, "Divide Whole Numbers"
  - Assignment Sheet 5, "Reduce Fractions to Lowest Terms"
  - Assignment Sheet 6, "Convert Mixed Numbers to Improper Fractions and Improper Fractions to Mixed Numbers"
  - Assignment Sheet 7, "Add Fractions"
  - Assignment Sheet 8, "Subtract Fractions"
  - Assignment Sheet 9, "Add Decimal Numbers"
  - Assignment Sheet 10, "Subtract Decimal Numbers"
  - Assignment Sheet 11, "Multiply Decimal Numbers"
  - Assignment Sheet 12, "Divide Decimal Numbers"
  - Assignment Sheet 13, "Convert Fractions to Decimals"
  - Assignment Sheet 14, "Read U.S. Customary and Metric Rules"
  - Student Supplement 2, "Metric/U.S. Customary Decimal Equivalents for Fractional Parts of an Inch"
  - Assignment Sheet 15, "Compute U.S. Customary/Metric Equivalents"
  - Student Supplement 3, "Metric/U.S. Customary Conversion Table"

- Review the teacher components presented for this unit in this teacher edition.
  - Learning Activities Sheet
  - Answers to Assignment Sheets
  - Written Test
  - Answers to Written Test
  - Unit Evaluation Form

  The **Learning Activities Sheet** is a step-by-step instruction sheet you may copy and distribute to your students to guide their individual study through the required components in the student edition (Objective Sheet, Information Sheet, Assignment Sheets).

- Modify the Learning Activities Sheet as needed to reflect your instructional plan. Copy and prepare the Learning Activity Sheet for distribution to your students.

Suggested Activities

- Copy and prepare the other teacher components you select to distribute to your students. (Written Test, Unit Evaluation Form)
- Prepare the classroom by putting up posters and charts and displaying articles and other references related to the objectives of this unit.

Delivery and application

Have students complete the steps in the Learning Activities Sheet, "Measuring and Related Math."

Evaluation

- Evaluate the assignment sheets. See the evaluation criteria listed at the top of each assignment sheet as well as the teacher page **Answers to Assignment Sheets**.
- Give the written test. See the teacher page **Written Test**.
- Evaluate the written test. See the teacher page **Answers to Written Test**.
- Compile written-test and assignment-sheet scores. See the teacher page **Unit Evaluation Form**.
- Reteach and retest as required.

Suggested resources

Resources used in developing this unit

Print media

- Hilley, Robert. *Power Product Equipment Technician: Theory and Principles of Engine Operation, Section A: Orientation.* Stillwater, Oklahoma: Multistate Academic and Vocational Curriculum Consortium, Inc., 1996.

Measuring and Related Math
Unit 3

Learning Activities Sheet

Put a checkmark in each blank as you complete each of the steps below.

_______ 1. **Read** Objective Sheet.

_______ 2. **Study** Information Sheet, Objectives 1 through 5.

_______ 3. **Do** Assignment Sheets 1 through 6.

_______ 4. **Stop** Have your instructor evaluate the completed assignment sheets. If the evaluation is satisfactory, continue to Step 5. If the evaluation is not satisfactory, repeat Steps 2 and 3 as your instructor directs.

_______ 5. **Do** Assignment Sheet 7, "Add Fractions."

_______ 6. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 7. If the evaluation is not satisfactory, repeat Step 5.

_______ 7. **Do** Assignment Sheet 8, "Subtract Fractions."

_______ 8. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 9. If the evaluation is not satisfactory, repeat Step 7.

_______ 9. **Do** Assignment Sheet 9, "Add Decimal Numbers."

_______ 10. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 11. If the evaluation is not satisfactory, repeat Step 9.

_______ 11. **Do** Assignment Sheet 10, "Subtract Decimal Numbers."

_______ 12. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 13. If the evaluation is not satisfactory, repeat Step 11.

_______ 13. **Do** Assignment Sheet 11, "Multiply Decimal Numbers."

_______ 14. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 15. If the evaluation is not satisfactory, repeat Step 13.

_______ 15. **Do** Assignment Sheet 12, "Divide Decimal Numbers."

_______ 16. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 17. If the evaluation is not satisfactory, repeat Step 15.

Continue to back of this page.

Learning Activities Sheet

_______ 17. **Do** Assignment Sheet 13, "Convert Fractions to Decimals."

_______ 18. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 19. If the evaluation is not satisfactory, repeat Step 17.

_______ 19. **Review** Student Supplement 2, "Metric/U.S. Customary Decimal Equivalents for Fractional Parts of an Inch."

_______ 20. **Do** Assignment Sheet 14, "Read U.S. Customary and Metric Rules."

_______ 21. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 22. If the evaluation is not satisfactory, repeat Steps 19 and 20.

_______ 22. **Review** Student Supplement 3, "Metric/U.S. Customary Conversion Table."

_______ 23. **Do** Assignment Sheet 15, "Compute U.S. Customary/Metric Equivalents."

_______ 24. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 25. If the evaluation is not satisfactory, repeat Steps 22 and 23.

_______ 25. **Take** Written Test.

_______ 26. **Stop** Have your instructor evaluate the completed written test. If the evaluation is satisfactory, proceed to the next learning activities sheet. If your evaluation is not satisfactory, ask your instructor for directions for reviewing the information in this unit.

Permission to duplicate this form is granted.

Measuring and Related Math
Unit 3

Answers to Assignment Sheets

Answers to required assignment sheets in student edition

Assignment Sheet 1

1. 11
2. 16
3. 13
4. 23
5. 108
6. 88
7. 242
8. 1538
9. 1917
10. 16,430

Assignment Sheet 2

1. 4
2. 7
3. 53
4. 406
5. 424
6. 283
7. 1175
8. 1810
9. 51,450
10. 89,722

Assignment Sheet 3

1. 42
2. 72
3. 324
4. 2884
5. 8410
6. 2028
7. 21,291
8. 165,478
9. 503,605
10. 5,458,852

Assignment Sheet 4

1. 4
2. 8
3. 91
4. 312
5. 3
6. 3
7. 62
8. 21
9. 2
10. 3

Assignment Sheet 5

1. ½
2. ½
3. 1
4. ¼
5. ⅓
6. ⅜
7. ½
8. 1 ⅓
9. 2 ½
10. 4 ½

Assignment Sheet 6

Part A

1. P
2. M
3. I
4. M
5. P
6. I
7. I
8. M
9. I
10. M
11. M
12. I
13. I
14. P
15. M

Answers to Assignment Sheets

Part B

1. 13/4
2. 9/2
3. 31/4
4. 17/2
5. 49/8
6. 11/2
7. 17/4
8. 19/2
9. 37/4
10. 33/2

Part C

1. 1 3/4
2. 4 1/2
3. 1 1/2
4. 1 7/8
5. 1 3/16
6. 1 3/8
7. 2 11/32
8. 2 1/2
9. 3 3/4
10. 2 1/16

Assignment Sheet 7

Part A

1. 3/4
2. 1 1/2
3. 1/2
4. 1
5. 1 3/16
6. 25/32
7. 29/32
8. 1 1/4
9. 1 5/16
10. 1 25/32

Part B

1. 14 3/4
2. 7 3/16
3. 19 5/8
4. 13 1/16
5. 4 1/4

Assignment Sheet 8

Part A

1. 9/16
2. 5/8
3. 3/16
4. 5/32
5. 3/4
6. 9/16
7. 1/16
8. 3/8
9. 17/32
10. 1/2

Part B

1. 3 1/4
2. 6 1/16
3. 31 19/32
4. 174 1/5
5. 11 3/64

Part C

1. 2/3
2. 1 5/8
3. 8 1/8
4. 1 11/32
5. 25 11/16
6. 7 1/4
7. 9/16
8. 1 11/16
9. 2/3
10. 38 9/16

Answers to Assignment Sheets

Part D

1. $\frac{2}{5}$
2. $49\frac{15}{16}$
3. $5\frac{2}{3}$
4. $9\frac{1}{2}$
5. $27\frac{1}{8}$
6. $2\frac{1}{4}$
7. $2\frac{1}{8}$
8. $3\frac{5}{16}$
9. $2\frac{1}{2}$
10. $3\frac{3}{16}$

Part E

1. $\frac{1}{8}$
2. $2\frac{7}{8}$
3. 10
4. $1\frac{3}{8}$
5. $3\frac{3}{4}$

Assignment Sheet 9

Part A

1. a. Tenths
   b. Hundredths
   c. Hundred thousandths
   d. Ten thousandths
   e. Thousandths

2. a. Hundredths
   b. Ten thousandths
   c. Tenths
   d. Thousandths
   e. Hundredths

3. a. $46.3\underline{8}26$
   b. $35.003\underline{8}$
   c. $148.\underline{2}96$
   d. $6758.2\underline{3}$
   e. $91.40\underline{8}2$
   f. $2\underline{0}4.37$
   g. $1\underline{4}.0079$
   h. $208.0\underline{9}7$
   i. $5.23\underline{9}81$
   j. $502.\underline{9}67$
   k. $5230.86\underline{7}$
   l. $58\underline{7}.029$
   m. $0.2\underline{9}8$
   n. $3\underline{2}9.768$
   o. $52.69\underline{4}$
   p. $498.\underline{2}76$
   q. $0.529\underline{6}$
   r. $\underline{4}68.539$
   s. $324.\underline{0}6$
   t. $56\underline{7}.8$

Part B

1.
$$\begin{array}{r} 0.024 \\ +\ \ .165 \\ \hline 0.189 \end{array}$$

2.
$$\begin{array}{r} 87.3 \\ +\ 370.\ \ \\ \hline 457.3 \end{array}$$

3.
$$\begin{array}{r} 15.127 \\ 3.4\ \ \ \\ .0091 \\ +\ 236.87\ \ \\ \hline 255.4061 \end{array}$$

4.
$$\begin{array}{r} 195.7 \\ 83.0 \\ +\ \ 9.006 \\ \hline 287.706 \end{array}$$

5.
$$\begin{array}{r} .5280 \\ 435.\ \ \ \ \ \\ 179.50\ \ \\ +\ \ 1.9\ \ \ \ \\ \hline 616.9280 \end{array}$$

Answers to Assignment Sheets

Part C

1. $39.00
2. $74.33
3. 23.9
4. 20.1
5. $16,018.26

Assignment Sheet 10

Part A

1. 351.98
2. 547.144
3. 141.013
4. 508.16
5. 749.25
6. $4.15
7. 670.4
8. 4107.34
9. $2.47
10. $197.45

Part B

1. $3317.32
2. 14.5
3. 2.84
4. 40.5
5. 27.5

Assignment Sheet 11

Part A

1. 8.184
2. 39.60
3. 1.1475
4. 297.5
5. 100.32
6. 6.4584
7. 0.4565
8. 25.38
9. 0.00069
10. 22.6352

Part B

1. $337.45
2. $6187.50
3. .28
4. $16.95
5. $18.72

Assignment Sheet 12

Part A

1. 9
2. 12.4
3. 0.5
4. 284
5. 33
6. 153
7. 1.5
8. 0.8
9. 1200
10. 2500

Part B

1. $4.78
2. 6
3. 8.2
4. 32
5. 30.3

Answers to Assignment Sheets

Assignment Sheet 13

Part A

1. 0.125
2. 0.25
3. 0.0625
4. 0.09375
5. 0.50
6. 0.75
7. 0.625
8. 0.875

Part B

1. g
2. j
3. d
4. a
5. i
6. b
7. c
8. f
9. h
10. e

Part C

1. 63.9
2. 5.93
3. 5.093
4. 5.0093
5. 3.825
6. 38.95
7. 38.095
8. 42.3
9. 402.3
10. 897.097

Part D

Tenth

1. 2.4
2. 4.2
3. 2.1
4. 4.1
5. .1

Hundredth

1. 14.02
2. .07
3. 1.09
4. .42
5. 73.90

Thousandth

1. 5.062
2. 8.840
3. 8.055
4. 5.017
5. 78.100

	Tenth	Hundredth	Thousandth
2.8354	2.8	2.84	2.835
4.6215	4.6	4.62	4.622
.2918	.3	.29	.292
.2065	.2	.21	.207
.1853	.2	.19	.185
5.6356	5.6	5.64	5.636
2.1523	2.2	2.15	2.152
4.6652	4.7	4.67	4.665

Answers to Assignment Sheets

Assignment Sheet 14

Part A

1. a. ¼"
b. ½"
c. 1 ¼"
d. 1 ¾"
e. 1 ¼"
f. 2 ½"
g. 1 ¼"
h. 2 ½"
i. 1 ½"
j. 4"

2. a. ⅜"
b. ¼"
c. 1 ⅛"
d. ¾"
e. 1 ½"
f. 2 ¾"
g. ½"
h. 2"
i. 4 ¼"
j. 2 ⅜"

3. a. 15/16"
b. ½"
c. 1 13/16"
d. ¾"
e. 1 11/16"
f. 3 5/16"
g. 1 ½"
h. 2 ⅝"
i. 4 ¼"
j. 1 ⅝"

4. a. 25/32"
b. 1 5/32"
c. ⅜"
d. 1 27/32"
e. 1 9/16"
f. 1 ½"
g. 1 3/16"
h. 2 13/16"
i. 4 9/32"
j. 1 15/16"

Part B

1. a. .08"
b. .40"
c. .58"
d. .80"
e. 1.28"
f. .09"
g. .38"
h. .84"
i. 1.07"
j. 1.45"

2. a. .15"
b. .50"
c. 1.25"
d. 1.80"
e. 2.85"
f. 3.95"
g. 4.35"
h. 4.95"
i. 5.35"
j. 5.85"

Part C

1. 5 mm
2. 20 mm
3. 37 mm
4. 49 mm
5. 73 mm
6. 6.5 mm
7. 17.5 mm
8. 30.5 mm
9. 50.5 mm
10. 69.5 mm

Assignment Sheet 15

Part A

1. 4.7
2. 8200
3. .017
4. 3600
5. .586
6. .784
7. 4.2
8. .436

Answers to Assignment Sheets

Part B

1. liters
2. kiloliters
3. liters
4. liters
5. milliliters
6. kiloliters
7. liters
8. milliliters
9. liters
10. liters

Part C

1. millimeters
2. kilometers
3. meters
4. centimeters
5. centimeters

Part D

1. 52.99
2. 1.4
3. 2.24
4. 16.09
5. 13.6
6. 1.7
7. 0.644
8. 1129.1
9. 134.28
10. 96.54

Part E

1. 58.8
2. 118.26
   9, 10.55

Measuring and Related Math
Unit 3

Written Test

Name _______________________________ Score _______________

1. Match to their correct definitions terms associated with math and measuring. Write the numbers on the blanks provided.

_______ a. Opposite operation of multiplication

_______ b. Process of totaling two or more numbers to find another number called a *sum*

_______ c. Fraction with an unwritten denominator of 10 or some power of 10; indicated with a point before the number

_______ d. Part of a whole; represents one or more equal parts of a unit

_______ e. Any one of the ten symbols, 0 to 9, by which all numbers can be expressed

_______ f. Metric unit used to measure mass or weight

_______ g. Abbreviated process of adding a number to itself a specified number of times

_______ h. Metric unit used to measure length

_______ i. Any of the natural numbers, both positive and negative, that represent a complete item

_______ j. Opposite operation of addition

_______ k. One part in a hundred; reckoned on the basis of a whole divided into one hundred parts

_______ l. Metric unit used to measure capacity

1. Addition
2. Decimal
3. Digit
4. Division
5. Fraction
6. Gram
7. Liter
8. Meter
9. Multiplication
10. Percent
11. Subtraction
12. Whole number

Written Test

2. Label the place values of the following whole number. Write how much each digit is worth on the blanks provided.

8, 4 9 2, 5 5 0

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

g. ____________________

3. Distinguish among types of fractions. Write a "P" in the blanks before proper fractions, an "I" before improper fractions, and an "M" before mixed numbers.

_______ a. 1420/1240

_______ b. 11/12

_______ c. 3/4

_______ d. 33/100

_______ e. 10/8

_______ f. 41 1/2

_______ g. 42/24

_______ h. 1 3/16

_______ i. 34/1000

_______ j. 11/10

4. Label the place values of the following decimal number. Write how much each digit is worth on the blanks provided.

0. 4 1 9 9

a. ____________________

b. ____________________

c. ____________________

d. ____________________

Written Test

5. Name the values of prefixes associated with metric measurement. On the blanks provided, write the correct value for each of the following metric terms.

______________________________ a. Centimeter (c)

______________________________ b. Milliliter (mL)

______________________________ c. Kilometer (Km)

______________________________ d. Hectogram (hg)

______________________________ e. Decimeter (dm)

______________________________ f. Dekaliter (daL)

Permission to duplicate this test is granted.

Measuring and Related Math
Unit 3

Answers to Written Test

1. a. 4
   b. 1
   c. 2
   d. 5
   e. 3
   f. 6
   g. 9
   h. 8
   i. 12
   j. 11
   k. 10
   l. 7

2. a. Units
   b. Tens
   c. Hundreds
   d. Thousands
   e. Ten thousands
   f. Hundred thousands
   g. Millions

3. a. I
   b. P
   c. P
   d. P
   e. I
   f. M
   g. I
   h. M
   i. P
   j. I

4. a. Ten thousandths
   b. Thousandths
   c. Hundredths
   d. Tenths

5. a. One hundredth of a meter
   b. One thousandth of a liter
   c. One thousand meters
   d. One hundred grams
   e. One tenth of a meter
   f. Ten liters

Measuring and Related Math
Unit 3

Unit Evaluation Form

Student name ______________________ Unit rating ____________

Assignment-sheet ratings

Assignment Sheet 1—Add Whole Numbers Rating ______

Comments: ____

____

Assignment Sheet 2—Subtract Whole Numbers Rating ______

Comments: ____

____

Assignment Sheet 3—Multiply Whole Numbers Rating ______

Comments: ____

____

Assignment Sheet 4—Divide Whole Numbers Rating ______

Comments: ____

____

Assignment Sheet 5—Reduce Fractions to Lowest Terms Rating ______

Comments: ____

____

Assignment Sheet 6—Convert Mixed Numbers to Improper Fractions and Improper Fractions to Mixed Numbers Rating ______

Comments: ____

____

Assignment Sheet 7—Add Fractions Rating ______

Comments: ____

____

Continue to back of this page.

Unit Evaluation Form

Assignment Sheet 8—Subtract Fractions Rating ________

Comments: ____

____

Assignment Sheet 9—Add Decimal Numbers Rating ________

Comments: ____

____

Assignment Sheet 10—Subtract Decimal Numbers Rating ________

Comments: ____

____

Assignment Sheet 11—Multiply Decimal Numbers Rating ________

Comments: ____

____

Assignment Sheet 12—Divide Decimal Numbers Rating ________

Comments: ____

____

Assignment Sheet 13—Convert Fractions to Decimals Rating ________

Comments: ____

____

Assignment Sheet 14—Read U.S. Customary and Metric Rules Rating ________

Comments: ____

____

Assignment Sheet 15—Compute U.S. Customary/Metric Equivalents Rating ________

Comments: ____

____

Continue to next page.

Unit Evaluation Form

Written-test scores

Pretest ___________ Posttest ___________ Other ___________

Comments: ____

____

Teacher signature ______________________________ Date ________________

Student signature ______________________________ Date ________________

Permission to duplicate this form is granted.

Thinking Skills
Unit 4

Suggested Activities

Instructional plan

Preparation Plan your presentation.

- Review the student components presented for this unit in the student edition.

  - Objective Sheet
  - Information Sheet
  - Assignment Sheet 1, "Use the Tools for Understanding the Creative Process to Analyze the Nature of a Recent Innovation"
  - Student Supplement 1, "Tools for Understanding the Creative Process"
  - Student Supplement 2, "An Example of How to Analyze the Creative Process"
  - Student Supplement 3, "Creating Opportunities for Creativity"
  - Assignment Sheet 2, "Use the Tools of Logical Thinking to Analyze a Situation"
  - Student Supplement 4, "Tools of Logical Thinking"
  - Assignment Sheet 3, "Apply the Problem-Solving Process to Improve the Quality of a Product or Service"
  - Student Supplement 5, "The Problem-Solving Process"
  - Lab Activity Sheet 1, "Create and Construct a Device That Will Extinguish a Candle Flame"
  - Lab Activity Sheet 2, "Create and Construct a Vessel That Will Float and Bear Weight"

- Review the teacher components presented for this unit in this teacher edition.

  - Learning Activities Sheet
  - Optional Assignment Sheet 1, "Solve a Transportation Problem"
  - Answers to Assignment Sheets
  - Optional Lab Activity Sheet 1, "Create and Construct a Container That Will Withstand a 10-Foot Drop"
  - Written Test
  - Answers to Written Test
  - Unit Evaluation Form

The **Learning Activities Sheet** is a step-by-step instruction sheet you may copy and distribute to your students to guide their individual study through the required components in the student edition (Objective Sheet, Information Sheet, Assignment Sheets, Student Supplements, Lab Activity Sheets).

Suggested Activities

Optional Assignment Sheet 1, "Solve a Transportation Problem," and **Optional Lab Activity 1, "Create and Construct a Container That Will Withstand a 10-Foot Drop,"** are activities you may want your students to do in addition to the assignment sheets and lab activities in the student edition. These activities provide students with additional practice in applying both the creative and logical thinking skills they learned about in the student edition.

- Modify the Learning Activities Sheet as needed to reflect your instructional plan. Copy and prepare the Learning Activities Sheet for distribution to your students.
- Copy and prepare the teacher components you select to distribute to your students (Written Test, Unit Evaluation Form).
- Prepare the classroom by putting up posters and charts and displaying articles and other references related to the objectives of this unit.

Delivery and application

Have students complete the steps in the Learning Activities Sheet, "Thinking Skills."

Evaluation

- Evaluate the assignment sheets. See the evaluation criteria listed at the top of each assignment sheet as well as the teacher page **Answers to Assignment Sheets**.
- Evaluate the lab activity sheets. See the evaluation criteria listed on the worksheet that accompanies each lab activity sheet.
- Give the written test. See the teacher page **Written Test**.
- Evaluate the written test. See the teacher page **Answers to Written Test**.
- Compile written-test, assignment-sheet, and lab-activity-sheet scores. See the teacher page **Unit Evaluation Form**.
- Reteach and retest as required.

Suggested resources

Resources used in developing this unit

Print media

- Barker, Joel Authur. *Future Edge: Discovering the New Paradigms for Success.* New York: William Morrow, 1992.
- Brocka, Bruce, and M. Suzanne Brocka. *Quality Management: Implementing the Best Ideas of the Masters.* Homewood, Illinois: Business One Irwin, 1992.
- Covey, Stephen R. *Principle-Centered Leadership.* New York: Summit Books, 1990.

Suggested Activities

- Dyer, W. Gibb, Jr. *The Entrepreneurial Experience: Confronting Career Dilemmas of the Start-Up Executive.* San Francisco: Jossey-Bass, 1992.
- Ernst and Young Quality Improvement Consulting Group. *Total Quality.* Homewood, Illinois: Business One Irwin, 1990.
- Gies, Frances, and Joseph Gies. *Cathedral, Forge, and Waterwheel: Technology and Invention in the Middle Ages.* New York: Harper Collins, 1994.
- Hawken, Paul. *Growing a Business.* New York: Fireside, 1987.
- Mooreman, Jerry W., and James W. Halloran. *Entrepreneurship.* Cincinnati: South-Western, 1993.
- Pinchot, Gifford, III. *Intrapreneuring: Why You Don't Have to Leave the Corporation to Become an Entrepreneur.* New York: Harper and Row, 1985.
- United States Department of Education. *Training Handbook.* Arlington, Virginia: United States Department of Education, Division of Quality Assurance, Institutional Quality Control Project, August, 1992.

Suggested supplemental resources

Nonprint media

- *Discovering the Future* is a three-video series narrated by futurist Joel A. Barker and distributed by Excellence in Training, 11358 Aurora Avenue, Des Moines, Iowa; phone 1-800-747-6569. Individual titles in this series are listed below.
  - "The Business of Paradigms"
  - "Paradigm Pioneers"
  - "The Power of Vision"

Thinking Skills
Unit 4

Learning Activities Sheet

Put a checkmark in each blank as you complete each of the steps below.

________ 1. **Read** Objective Sheet.

________ 2. **Study** Information Sheet, Objectives 1 and 2, and Student Supplements 1 through 3.

________ 3. **Do** Assignment Sheet 1, "Use the Tools for Understanding the Creative Process to Analyze the Nature of a Recent Innovation."

________ 4. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 5. If the evaluation is not satisfactory, repeat Steps 2 and 3.

________ 5. **Study** Information Sheet, Objective 3, and Student Supplement 4, "Tools of Logical Thinking."

________ 6. **Do** Assignment Sheet 2, "Use the Tools of Logical Thinking to Analyze a Situation."

________ 7. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 8. If the evaluation is not satisfactory, repeat Steps 5 and 6.

________ 8. **Read** Student Supplement 5, "The Problem-Solving Process."

________ 9. **Do** Assignment Sheet 3, "Apply the Problem-Solving Process to Improve the Quality of a Product or Service."

________ 10. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 11. If the evaluation is not satisfactory, repeat Steps 8 and 9.

________ 11. **Do** Lab Activity Sheet 1, "Create and Construct a Device That Will Extinguish a Candle Flame."

________ 12. **Stop** Have your instructor evaluate the completed lab activity. If the evaluation is satisfactory, continue to Step 13. If the evaluation is not satisfactory, repeat Step 11.

________ 13. **Do** Lab Activity Sheet 2, "Create and Construct a Vessel That Will Float and Bear Weight."

________ 14. **Stop** Have your instructor evaluate the completed lab activity. If the evaluation is satisfactory, continue to Step 15. If the evaluation is not satisfactory, repeat Step 13.

Continue to back of this page.

Learning Activities Sheet

_______ 15. **Stop** Check with your instructor for any optional activities he or she may choose to assign.

_______ 16. **Do** Optional activities listed below.

_______ 17. **Stop** Have your instructor evaluate the optional activities. If the evaluation is satisfactory, continue to Step 18. If the evaluation is not satisfactory, repeat Step 16 as your instructor directs.

_______ 18. **Take** Written Test.

_______ 19. **Stop** Have your instructor evaluate the completed written test. If the evaluation is satisfactory, proceed to the next learning activities sheet. If your evaluation is not satisfactory, ask your instructor for directions for reviewing the information in this unit.

Permission to duplicate this form is granted.

Thinking Skills
Unit 4

Optional Assignment Sheet 1—Solve a Transportation Problem

Name ______________________________ Date ______________

Evaluation criteria **Rating**

Directions have been followed. ______

Answers to questions are well thought out, relevant, complete, and reflect knowledge of the information presented in the student edition in the Information Sheet and in Student Supplements 1 through 5. ______

Overall rating ______

Evaluator's comments ______________________________

____

____

Introduction In this assignment, you will get further practice in using the creative and logical thinking skills you have learned about in the information sheet and in Student Supplements 1 through 5 in the student edition.

Exercise

Activity checklist Put a checkmark on the blank line before each activity below as you complete it.

______ 1. Plan a cross-country trip to either Portland, Oregon, or Boston, Massachusetts (whichever is farther away from your present location). Pretend that you are planning the trip in the year 1885, and you will be leaving in the month of September. You will have enough money to buy all your supplies before you leave on the trip, but you will only have $20 in your pocket when you leave.

Write an essay that analyzes the steps you should take in planning your trip. In your essay, you must answer the items in the **Analysis Check** on the next page.

______ 2. Turn your essay in to your instructor for evaluation.

______ 3. Your instructor will return your essay with suggestions for improvement. **Make the improvements** your instructor suggests, and then, return your essay to your instructor for **final evaluation**.

Optional Assignment Sheet 1

Analysis Check

1. How many miles will you have to travel on the trip? Include a map of the route you will take on the trip.
2. What modes of transportation were available to travelers in 1885? Which mode(s) will you use on the trip?
3. How many weeks will you need to complete the trip using the mode(s) of transportation you have selected?
4. How will you provide for food on the trip?
5. What clothing will you need for the trip?
6. What other supplies/equipment will you need for the trip?
7. List three other problems you will have to face on the trip. How will you solve these problems?

Permission to duplicate this assignment is granted.

Thinking Skills
Unit 4

Answers to Assignment Sheets

Answers to required assignment sheets in student edition

Assignment Sheet 1—Answers will vary. Student performance should be evaluated according to the criteria listed on the assignment sheet.

Assignment Sheet 2—Answers will vary. Student performance should be evaluated according to the criteria listed on the assignment sheet.

Assignment Sheet 3—Answers will vary. Student performance should be evaluated according to the criteria listed on the assignment sheet.

Answers to optional assignment sheet in teacher edition

Assignment Sheet 1—Answers will vary. Student performance should be evaluated according to the criteria listed on the assignment sheet.

Thinking Skills
Unit 4

Optional Lab Activity Sheet 1—Create and Construct a Container That Will Withstand a 10-Foot Drop

Introduction

In the student edition, you have practiced the creative and logical thinking skills you have learned in the information sheet and assignment sheets to create and then construct an original device to extinguish a candle flame and vessel that will float and bear weight.

In this optional lab activity, you will create and construct a container that will withstand a 10-foot drop. You will accomplish this task by following the guidelines listed in the procedure steps below.

Procedure

Put a checkmark on the blank line before each step below as you complete it.

________ 1. You will study the rules and regulations for this activity, which are presented below.

Rules and regulations

- You must design a container that meets the following specifications:
    - — The total cost of the materials you use in your design cannot exceed 2 dollars.
    - — A hollow "cargo compartment" must be incorporated into the design of your container. This cargo compartment will shelter a raw egg when the container is dropped.
    - — The combined weight of the container and the raw egg cannot exceed 2 pounds.
    - — The container's total volume cannot exceed 1 cubic foot.
- After you construct your container, it will be tested in a class competition that uses the following rules:
    - — During the test, your instructor will drop the weighed container with raw egg from a 10-foot height. The egg in the container must remain unbroken after the container is dropped. Penalty points will be deducted from the rating for an unsuccessful attempt—the egg in the container breaks after the 10-foot drop.

— The container in which the egg can withstand the greatest drop without breaking wins the competition. The provisional winner of the competition must break the egg to prove that the egg is raw.

_______ 2. Review the following worksheet associated with this lab activity.

_______ 3. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the information you have written and the equipment/materials you have listed for performing the procedure.

_______ 4. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

_______ 5. Using the instructor-approved information and equipment/materials list on the worksheet, construct the container.

_______ 6. Test the container. Your instructor will rate your performance using the evaluation criteria listed in Part B on the worksheet.

Optional Lab Activity Sheet 1

Worksheet—Create and Construct a Container That Will Withstand a 10-Foot Drop

Name ______________________________ Date ______________

Part A: **Pre-performance check**

Complete the following information concerning the design of the container.

- In the space provided below (or on a separate sheet of paper), draw a design of the container you will construct and write a description of how you believe the container will function.

- In the space below, list the materials required to construct the container you have designed. Also, list the cost of each of those materials.

Instructor's signature ______________________________

Optional Lab Activity Sheet 1

Worksheet—Create and Construct a Container That Will Withstand a 10-Foot Drop

---

Part B: Performance evaluation

Evaluation criteria	**Rating**
Design of the container meets the rules and regulations set for the procedure.	______
Design of the container is creative and unique.	______
Presentation of the design drawing and description of the container is neat, accurate, and well organized visually.	______
During the test, the container functions according to the rules and regulations set in the procedure.	______
Note to evaluator: Penalty points must be deducted if the egg breaks when the container is dropped from the 10-foot height.	
Lab clean-up and follow-up actions were satisfactory.	______
Overall rating	______

Evaluator's comments ____

____

____

Permission to duplicate this lab activity is granted.

Thinking Skills
Unit 4

Written Test

Name ______________________________ Score ______________

1. Define the major types of thinking skills. Write your answers on the blanks provided beside each of the terms below.

   a. **Creative thinking** ______________________________

   ____

   b. **Logical thinking** ______________________________

   ____

2. Distinguish between definitions of the aspects of creative thinking. Put an "Innov" on the blank before the definition of *innovation* and an "Int" on the blank before the definition of *intuition*.

   _______ a. Two-stage process consisting first of *invention* and second of *application*

   _______ b. Ability to make quick, accurate judgments without factual evidence or, sometimes, contradictory to the factual evidence

3. Distinguish between definitions of the aspects of logical thinking. Put an "An" on the blank before the definition of *analysis* and an "Eval" on the blank before the definition of *evaluation*.

   _______ a. Process of determining the relative merits and weaknesses of an object, process, or theory

   _______ b. Process of breaking down an object, process, or theory into its basic parts in order to understand it

Permission to duplicate this test is granted.

Thinking Skills
Unit 4

Answers to Written Test

1. a. Process of imagining and producing original methods and tools for understanding the world and dealing with it

   b. Process of gathering factual evidence, analyzing it, and evaluating it

2. a. Innov
   b. Int

3. a. Eval
   b. An

Thinking Skills
Unit 4

Unit Evaluation Form

Student name ______________________________ Unit rating ______________

Assignment-sheet ratings

Assignment Sheet 1—Use the Tools for Understanding the Creative Process to Analyze the Nature of a Recent Innovation Rating ________

Comments: ____

____

____

Assignment Sheet 2—Use the Tools of Logical Thinking to Analyze a Situation Rating ________

Comments: ____

____

____

Assignment Sheet 3—Apply the Problem-Solving Process to Improve the Quality of a Product or Service Rating ________

Comments: ____

____

____

Lab-activity-sheet ratings

Lab Activity Sheet 1—Create and Construct a Device That Will Extinguish a Candle Flame Rating ________

Comments: ____

____

____

Continue to back of this page.

Unit Evaluation Form

Lab Activity Sheet 2—Create and Construct a Vessel That Will Float and Bear Weight   Rating ________

Comments: ____

____

____

List optional assignments and ratings.

Written-test scores

Pretest ________   Posttest ________   Other ________

Comments: ____

____

____

Teacher signature ____________________ Date ____________

Student signature ____________________ Date ____________

Permission to duplicate this form is granted.

Career-Exploration Process
Unit 5

Suggested Activities

Instructional plan

Preparation Plan your presentation.

- Review the student components presented for this unit in the student edition.
    - — Objective Sheet
    - — Information Sheet
    - — Assignment Sheet 1, "Gather Personal Information"
    - — Assignment Sheet 2, "Gather General Job Information and Identify Occupational Area of Choice"
    - — Student Supplement 1, "Career Search Booklet"
    - — Assignment Sheet 3, "Gather Specific Job Information"
    - — Student Supplement 2, "Job-Information Report Form"
    - — Assignment Sheet 4, "Make Career Decision"
    - — Student Supplement 3, "Job-Comparison Worksheet"
    - — Assignment Sheet 5, "Develop a Plan of Action to Meet Career Goal"
    - — Student Supplement 4, "Career Objectives"
    - — Student Supplement 5, "What You Can Do This Year"
    - — Student Supplement 6, "What You Can Do in High School"
    - — Student Supplement 7, "What You Can Do After High School"
    - — Student Supplement 8, "Career Plan of Action"
- Review the teacher components presented for this unit in this teacher edition.
    - — Learning Activities Sheet
    - — Optional Information Sheet, "Educational and Training Levels"
    - — Optional Information Sheet, "Sample Plan of Action"
    - — Teacher Supplement 1, "Extra Copies of Student Supplements 2 through 8"
    - — Answers to Assignment Sheets
    - — Written Test
    - — Answers to Written Test
    - — Unit Evaluation Form

The **Learning Activities Sheet** is a step-by-step instruction sheet you may copy and distribute to your students to guide their individual study through the required components in the student edition (Objective Sheet, Information Sheet, Assignment Sheets, Student Supplements).

Optional Information Sheet 1, "**Education and Training Levels**" is an additional information sheet you may hand out to your students when they begin Assignment Sheet 3, "Gather Specific Job Information." This optional information sheet explains what is meant by certain terms (such as OJT, apprenticeship, etc.) used in the standard job-research publications.

Suggested Activities

Optional Information Sheet 2, **"Sample Plan of Action,"** is an additional information sheet you may hand out to your students when they begin Assignment Sheet 5, "Develop a Plan of Action to Meet Career Goal." This optional information sheet provides a sample of the type of plan the student will provide when he or she has followed the steps in completing this assignment.

Teacher Supplement 1, **"Extra Copies of Student Supplements 2 through 8"** provides you with clean copies of the forms students will need to complete Assignment Sheets 3 through 5. Only one copy of each of these forms is presented in the student edition, and it is likely that students will need extra photocopies of these forms to complete the assignments.

- Modify the Learning Activities Sheet as needed to reflect your instructional plan. Copy and prepare the Learning Activities Sheet for distribution to your students.
- Copy and prepare the teacher components you select to distribute to your students (Written Test, Unit Evaluation Form).
- Prepare the classroom by putting up posters and charts and displaying articles and other references related to the objectives of this unit.

Delivery and application

Have students complete the steps in the Learning Activities Sheet, "Career-Exploration Process."

Evaluation

- Evaluate the assignment sheets. See the evaluation criteria listed at the top of each assignment sheet as well as the teacher page **Answers to Assignment Sheets**.
- Give the written test. See the teacher page **Written Test**.
- Evaluate the written test. See the teacher page **Answers to Written Test**.
- Compile written-test and assignment-sheet scores. See the teacher page **Unit Evaluation Form**.
- Reteach and retest as required.

Suggested resources

Resources used in developing this unit

Print media

- *Exploring Aeronatics and Space Technology.* Stillwater, Oklahoma: Mid-America Vocational Curriculum Consortium, Inc., and the Aviation and Space Education Department, Oklahoma State University, 1991.
- Kelly, Joan, and Ruth Volz-Patton. *Career Skills.* Encino, California: Glencoe Publishing Company, 1987.

Suggested Activities

- Lynch, Richard L., and Edwin L. Herr. *Career Core Competencies: Getting the Job.* New York: Gregg Division, McGraw-Hill Book Company, 1977.

Resources used as student references

The materials listed below were used as resources in preparing Student Supplement 1, "Career Search Booklet."

- *Career Search Occupational Abstracts.* Stillwater, Oklahoma: Oklahoma Department of Vocational and Technical Education. Career Information Division.

  Oklahoma teachers may order a computerized version of the Career Search program for either Apple, IBM, or IBM-compatible computers by contacting

  Attention: Ms. Kelly Arrington
  Career Information
  Oklahoma Department of Vocational
  and Technical Education
  1500 West Seventh Avenue
  Stillwater, OK 74074-4364

  Phone: 405-743-5159

  Teachers in other states may order a similar computerized program from

  COIN Education Products
  3361 Executive Parkway, Suite 302
  Toledo, OH 43606

  Phone: 1-800-274-8515.

Career-Exploration Process
Unit 5

Learning Activities Sheet

Put a checkmark in each blank as you complete each of the steps below.

_______ 1. **Read** Objective Sheet.

_______ 2. **Study** Information Sheet, Objectives 1 and 2.

_______ 3. **Do** Assignment Sheet 1, "Gather Personal Information."

_______ 4. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 5. If the evaluation is not satisfactory, repeat Steps 2 and 3.

_______ 5. **Do** Assignment Sheet 2, "Gather General Job Information and Identify Occupational Area of Choice."

_______ 6. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 7. If the evaluation is not satisfactory, repeat Step 5.

_______ 7. **Do** Assignment Sheet 3, "Gather Specific Job Information."

_______ 8. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 9. If the evaluation is not satisfactory, repeat Step 7.

_______ 9. **Do** Assignment Sheet 4, "Make a Career Decision."

_______ 10. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 11. If the evaluation is not satisfactory, repeat Step 9.

_______ 11. **Do** Assignment Sheet 5, "Develop a Plan of Action to Meet Career Goal."

_______ 12. **Stop** Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 13. If the evaluation is not satisfactory, repeat Step 11.

_______ 13. **Stop** Check with your instructor for any optional activities he or she may choose to assign.

Continue to back of this page.

Learning Activities Sheet

_______ 14. **Do** Optional activities listed below.

____

____

____

____

____

____

____

____

____

____

_______ 15. **Stop** Have your instructor evaluate the optional activities. If the evaluation is satisfactory, continue to Step 16. If the evaluation is not satisfactory, repeat Step 14 as your instructor directs.

_______ 16. **Take** Written Test.

_______ 17. **Stop** Have your instructor evaluate the completed written test. If the evaluation is satisfactory, proceed to the next learning activities sheet. If your evaluation is not satisfactory, ask your instructor for directions for reviewing the information in this unit.

Permission to duplicate this form is granted.

Career-Exploration Process
Unit 5

Optional Information Sheet 1—Education and Training Levels

Type	Description	Length of training	Transfer credit
OJT	On-the-job training is specific training by the employer. This includes military service.	Usually less than 6 months	
HS diploma	This entry-level training is offered at comprehensive high schools.	1 to 3 years	Some credits may be transferable to postsecondary programs.
Certificate	This training centers on specific skills of a particular occupation. It may be offered through vocational schools or community colleges.	3 months to 2 years	
Apprenticeship	This formal training program involves work experience and classroom instruction.	2 to 5 years	Only credits earned in a college may be transferable.
Associate degree	This training in specific vocations is offered at community colleges.	2 years	Some credits may be transferable to 4-year programs.
Bachelor's degree	This formal training program leads to a degree from a college or university.	4 years	Credits may be transferable between colleges and universities.
Master's degree	This advanced degree is required for entry into certain careers.	1 to 2 years beyond a bachelor's	Credits may be transferable between colleges and universities.
Doctorate	This training is for such professions as physician, dentist, lawyer, pastor, scientist, and college teacher.	3 to 5 years beyond a bachelor's	Credits may be transferable from one program to another.

Permission to duplicate this information sheet is granted.

Career-Exploration Process
Unit 5

Optional Information Sheet 2—Sample Plan of Action

Mary's Plan of Action

Career goal: Aerospace Engineer

1997	
June-Aug.	Take job to begin saving for college
Sept.-Dec.	Take first-semester Algebra Take first-semester English Take first-semester Principles of Technology Decrease hours at work to no more than 20 hours per week
1998	
Jan.-May	Complete Algebra Complete English Complete Principles of Technology Continue working
June-Aug.	Increase hours at work
Sept.-Dec.	Take Geometry Take Chemistry Take English Decrease work hours to no more than 20 hours per week
1999	
Jan.-May	Complete Geometry Complete Chemistry Complete English
June-Aug.	Begin research to find colleges with good aerospace programs Increase hours at work
Sept.-Dec.	Send out letters of inquiry to colleges of interest Take Trigonometry Take English Decrease work hours to no more than 20 hours per week Select college of choice
2000	
Jan.-May	Register for college Complete Trigonometry Complete English Graduate
June-Aug.	Find part-time job for college
Sept.-Dec.	Complete first-semester college

BEST COPY AVAILABLE

Optional Information Sheet 2

Plan of Action
(cont.)

2001	Complete fourth-semester college Find summer internship in aerospace industry and secure employment for following summers Complete third-semester college
2002	Complete fourth-semester college Complete summer internship in aerospace industry Complete fifth-semester college
2003	Complete sixth-semester college Complete summer internship in aerospace industry and do research on companies that may provide future employment Complete seventh-semester college Prepare résumé and begin career search
2004	Complete eighth-semester college Send out résumés and complete career search Graduate Obtain employment as an aerospace engineer

Permission to duplicate this information sheet is granted.

Career-Exploration Process
Unit 5

Teacher Supplement 1—Extra Copies of Student Supplements 2 through 8

Note to instructor

This teacher supplement provides you with clean copies of Student Supplements 2 through 8 in the student edition. Student Supplements 2 through 8 are forms the students will need to complete Assignment Sheets 3 through 5. In the student edition, students are only given one copy of each of these forms. You may use these clean copies to make extra photocopies of the forms your students may need to complete the assignments.

Permission to duplicate the following forms is granted.

Career-Exploration Process
Unit 5

Student Supplement 2—Job-Information Report Form

Directions Use the following form for gathering and comparing information about the specific jobs you wish to explore in Assignment Sheet 3.

Nature of the occupation ______________________________

____

____

____

____

____

____

____

____

____

____

Working conditions ______________________________

____

____

____

____

____

____

____

____

____

____

Student Supplement 2

Worker requirements ____________________

Earnings and opportunities ____________________

Student Supplement 2

Employment outlook ______________________________

Education/training required ______________________________

Career-Exploration Process
Unit 5

Student Supplement 3—Job-Comparison Worksheet

Directions In the boxes under the column heading "Job choice," list the five jobs you reported on in Assignment Sheet 3. In the boxes under the column heading "Advantages," list beside each job choice the advantages you imagine each job would have. In the boxes under the heading "Disadvantages," list beside each job choice the disadvantages you imagine each job would have.

Job choice	Advantages	Disadvantages
1.		
2.		

Student Supplement 3

Job choice	Advantages	Disadvantages
3.		
4.		
5.		

Career-Exploration Process
Unit 5

Student Supplement 4—Career Objectives

Directions In the blank provided below, write your career goal. Then, using the job information you have gathered, list under the proper heading the education and training you will need, the equipment you will need, and jobs you think you will need to obtain in order to reach your career goal. These lists will become your career objectives.

Career goal ____

Education and training required to meet your career goal

Student Supplement 4

Equipment needed to meet your career goal

Student Supplement 4

Jobs required to meet your career goal

Career-Exploration Process
Unit 5

Student Supplement 5—What You Can Do This Year

Directions Review the three lists you made in Student Supplement 4, and then select short-term objectives from those lists. Write these short-term objectives under the proper heading on this form.

Short-term objectives for education and training needed to meet your career goal

Short-term objectives for equipment needed to meet your career goal

Student Supplement 5

Short-term objectives for jobs required to meet your career goal

Career-Exploration Process
Unit 5

Student Supplement 6—What You Can Do in High School

Directions Review the three lists you made in Student Supplement 4, and then select from those lists long-term objectives you can meet while you are in high school. Write these long-term objectives under the proper heading on this form.

Long-term educational and training objectives you can meet while you are in high school

Long-term equipment-need objectives you can meet while you are in high school

Student Supplement 6

Long-term job objectives you can meet while you are in high school

Career-Exploration Process
Unit 5

Student Supplement 7—What You Can Do After High School

Directions Review the three lists you made in Student Supplement 4, and then select from those lists long-term objectives you can meet after you graduate from high school. Write these long-term objectives under the proper heading on this form.

Long-term educational and training objectives you can meet after you graduate from high school

Long-term equipment-need objectives you can meet after you graduate from high school

Student Supplement 7

Long-term job objectives you can meet after you graduate from high school

Career-Exploration Process
Unit 5

Student Supplement 8—Career Plan of Action

Directions Review the lists you have made in Student Supplements 5, 6, and 7 and assign dates to each objective. Using these lists and dates, complete this form by listing all your objectives according to the dates you have assigned.

Career goal ____

Year	Objective

Student Supplement 8

Year	Objective

Career-Exploration Process
Unit 5

Answers to Assignment Sheets

Answers to required assignment sheets in student edition

Assignment Sheets 1 through 5—Answers will vary. Student performance should be evaluated according to the criteria listed on the assignment sheet.

Evaluator's note: The content of personal opinions requested of the student in these assignment sheets should not be graded per se; there are no right or wrong answers. In evaluating these assignment sheets, the evaluator should look for seriousness of effort and completeness rather than for correctness.

Career-Exploration Process
Unit 5

Written Test

Name ______________________________ Score ______________

1. Match terms associated with career exploration to their correct definitions. Write the numbers on the blanks provided.

_______ a. Activity you have been trained to do and have practiced doing

_______ b. Path a person follows within an occupational area

_______ c. Thing, subject, or activity in life that you like to do or that makes you happy

_______ d. Group of jobs similar according to the nature of the work being performed

_______ e. Personal judgment concerning the importance or worth of a thing or quality

_______ f. Planned or responsible activity a person performs with the expectation of a return for his or her efforts

_______ g. Talent or potential for being able to do something

1. Aptitude
2. Career
3. Interest
4. Job
5. Occupational area
6. Skill
7. Value

2. List the steps in the career-exploration process. Write your answers on the blanks provided.

a. Step 1 ______________________________

b. Step 2 ______________________________

c. Step 3 ______________________________

d. Step 4 ______________________________

e. Step 5 ______________________________

f. Step 6 ______________________________

g. Step 7 ______________________________

Permission to duplicate this test is granted.

Career-Exploration Process
Unit 5

Answers to Written Test

1. a. 6
   b. 2
   c. 3
   d. 5
   e. 7
   f. 4
   g. 1

2. a. Gather personal information.
   b. Gather general job information.
   c. Identify occupational area of choice.
   d. Gather specific job information to compare jobs within an occupational area of choice.
   e. Make a career decision (define a career goal).
   f. Develop a plan of action to meet career goal.
   g. Evaluate career goal and plan of action.

Career-Exploration Process
Unit 5

Unit Evaluation Form

Student name ______________________________ Unit rating ______________

Assignment-sheet ratings

Assignment Sheet 1—Gather Personal Information Rating ________

Comments: ____

____

____

Assignment Sheet 2—Gather General Job Information and Identify Occupational Area of Choice Rating ________

Comments: ____

____

____

Assignment Sheet 3—Gather Specific Job Information Rating ________

Comments: ____

____

____

Assignment Sheet 4—Make a Career Decision Rating ________

Comments: ____

____

____

Assignment Sheet 5—Develop a Plan of Action to Meet Career Goal Rating ________

Comments: ____

____

____

Continue to back of this page.

Unit Evaluation Form

List optional assignments and ratings

Written-test scores

Pretest ____________ Posttest ____________ Other ____________

Comments: ____

____

____

Teacher signature ______________________________ Date ________________

Student signature ______________________________ Date ________________

Permission to duplicate this form is granted.

Evaluating the Consequences of Using Technology
Unit 6

Suggested Activities

Instructional plan

Preparation Plan your presentation.

- Review the student components presented for this unit in the student edition.
  - — Objective Sheet
  - — Information Sheet
  - — Assignment Sheet 1, "Evaluate the Consequences of Your Television-Watching Habits"
  - — Assignment Sheet 2, "Evaluate the Consequences of Your Family's Present Recycling Habits"
  - — Student Supplement 1, "Environmental Primer"
  - — Lab Activity Sheet 1, "Collect a Sample of the Particulate Matter in the Air"
- Review the teacher components presented for this unit in this teacher edition.
  - — Learning Activities Sheet
  - — Teacher Supplement 1, "Using the AIT Media Program"
  - — Optional Assignment Sheet 1, "AIT Media Questions for Discussion and Review"
  - — Answers to Assignment Sheets
  - — Written Test
  - — Answers to Written Test
  - — Unit Evaluation Form

The **Learning Activities Sheet** is a step-by-step instruction sheet you may copy and distribute to your students to guide their individual study through the required components in the student edition (Objective Sheet, Information Sheet, Assignment Sheets, Student Supplement, Lab Activity Sheet).

Note that Step 2 on the Learning Activities Sheet asks the student to obtain a copy of the questionnaire, "Questions for Discussion and Review," and Step 3 asks the student to watch an unnamed media presentation and complete the questions for discussion and review.

You may obtain and show the AIT media presentation designed to go with this unit. **Teacher Supplement 1**, "**Using the AIT Media Program**," summarizes the content of this presentation (see the Suggested Supplemental Materials section below for ordering information).

Suggested Activities

If you select the AIT presentation, write the name of that media presentation on the blank line in the Learning Activities Sheet, or if you have selected another media presentation to use with your class, write in the title of that presentation.

If you use the AIT presentation, you may use **Optional Assignment Sheet 1, "AIT Media Questions for Discussion and Review,"** in Step 3, which asks students to complete questions for discussion and review. If you use another media presentation, you should prepare your own questionnaire to be used with Step 3 on the Learning Activities Sheet and title it "Questions for Discussion and Review."

- Modify the Learning Activities Sheet as needed to reflect your instructional plan. Copy and prepare the Learning Activities Sheet for distribution to your students.
- Copy and prepare the teacher components you select to distribute to your students (Written Test, Unit Evaluation Form).
- Prepare the classroom by putting up posters and charts and displaying articles and other references related to the objectives of this unit.

Delivery and application

Have students complete the steps in the Learning Activities Sheet, "Evaluating the Consequences of Using Technology."

Evaluation

- Evaluate the assignment sheets. See the evaluation criteria listed at the top of each assignment sheet as well as the teacher page **Answers to Assignment Sheets**.
- Evaluate the lab activity sheet. See the evaluation criteria listed on the worksheet that accompanies each lab activity sheet.
- Give the written test. See the teacher page **Written Test**.
- Evaluate the written test. See the teacher page **Answers to Written Test**.
- Compile written-test, assignment-sheet, and lab-activity-sheet scores. See the teacher page **Unit Evaluation Form**.
- Reteach and retest as required.

Suggested resources

Resources used in developing this unit

Print media

- Badrkhan, Kamiran S., Willard R. Daggett, and Charles R. Williams. *Technology for Tomorrow.* Cincinnati, Ohio: South-Western Publishing Co., 1985.
- Barden, Robert, and Michael Hacker. *Living with Technology.* Albany, New York: Delmar Publishers, 1988.

Suggested Activities

- Bohn, Ralph, et al. *Energy, Power, and Transportation Technology.* Encino, California: Glencoe Publishing Company, 1986.
- Goetsch, David L., and John A. Nelson. *Technology and You.* Albany, New York: Delmar Publishers, Inc., 1987.
- McCrory, David L., Karen I. Todd, and Ronald D. Todd. *Understanding and Using Technology.* Worchester, Massachusetts: Davis Publications, Inc., 1985.
- Smith, Howard "Bud," and R. Thomas Wright. *Understanding Technology.* South Holland, Illinois: The Goodheart-Willcox Company, Inc., 1989.

Suggested supplemental resources

Nonprint media

- AIT media program, *People, Technology, and the Environment,* copyright 1990.

  Available from:

  Agency for Instructional Technology (AIT)
  Box A
  Bloomington, Indiana 47402

  Phone: (800) 457-4509 or (812) 339-2203

Evaluating the Consequences of Using Technology
Unit 6

Learning Activities Sheet

Put a checkmark in each blank as you complete each of the steps below.

________	1.	**Read**	Objective Sheet.
________	2.	**Stop**	Check with your instructor and obtain a copy of the questionnaire "Questions for Discussion and Review."
________	3.	**Watch**	Media presentation ______________________________ ____
		and	
		Complete	"Questions for Discussion and Review."
________	4.	**Study**	Information Sheet, Objectives 1 through 3.
________	5.	**Do**	Assignment Sheet 1, "Evaluate the Consequences of Your Television-Watching Habits."
________	6.	**Stop**	Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 7. If the evaluation is not satisfactory, repeat Step 5.
________	7.	**Study**	Student Supplement 1, "Environmental Primer."
________	8.	**Do**	Assignment Sheet 2, "Evaluate the Consequences of Your Family's Present Recycling Habits."
________	9.	**Stop**	Have your instructor evaluate the completed assignment sheet. If the evaluation is satisfactory, continue to Step 10. If the evaluation is not satisfactory, repeat Steps 7 and 8.
________	10.	**Do**	Lab Activity Sheet 1, "Collect a Sample of the Particulate Matter in the Air."
________	11.	**Stop**	Have your instructor evaluate the completed lab activity sheet. If the evaluation is satisfactory, continue to Step 12. If the evaluation is not satisfactory, repeat Step 10.
________	12.	**Stop**	Check with your instructor for any optional activities he or she may choose to assign.

Continue to back of this page.

Learning Activities Sheet

_______ 13. **Do** Optional activities listed below.

_______ 14. **Stop** Have your instructor evaluate the optional activities. If the evaluation is satisfactory, continue to Step 15. If the evaluation is not satisfactory, repeat Step 13 as your instructor directs.

_______ 15. **Take** Written Test.

_______ 16. **Stop** Have your instructor evaluate the completed written test. If the evaluation is satisfactory, proceed to the next learning activities sheet. If your evaluation is not satisfactory, ask your instructor for directions for reviewing the information in this unit.

Permission to duplicate this form is granted.

Evaluating the Consequences of Using Technology
Unit 6

Teacher Supplement 1—Using the AIT Media Program

Program name AIT media, "People, Technology, and the Environment"

Program summary This program examines how the choices we make in using technology have both benefits and risks. Opening with footage of the first atomic bomb at Alamogordo, the program uses sequences from silent films, newsreel footage, and animation to present the car as an example of a technological breakthrough of profound effects for good and ill—more jobs, transportation for all, but pollution and the "greenhouse effect." Mountain bikes and modern packaging have similarly mixed consequences. A visit to a recycling plant shows how trash can be recycled and converted to energy.

The program moves to the awarding of Nobel Prizes in Stockholm and footage of the early life of Alfred Nobel, who created dynamite to replace extremely dangerous and explosive nitroglycerin. Appalled when dynamite was put to destructive uses in war, he established the prizes, including one for peace. The program returns to Alamogordo, where the bomb explodes, which later was used to end World War II and usher in a new era. The narrator reminds us that atomic power—like all technology—is neutral. Its consequences can benefit us greatly or endanger us. We must make wise choices about the use of technologies (such as pesticides) and solve the problems they create.

Program objectives The media program is designed to illustrate that

- technology is employed in response to problems.
- technology products have consequences; some are anticipated and desired; others are not anticipated or desired.
- we must decide which technology products are appropriate in a given situation.

Evaluating the Consequences of Using Technology
Unit 6

Optional Assignment Sheet 1—AIT Media Questions for Discussion and Review

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	_______
Student responses are relevant and well thought out.	_______
Overall rating	_______

Evaluator's comments ____

____

____

Exercise

Directions As you watch the AIT media presentation, answer the following questions in the space provided below each question.

Discussion/ review questions

1. In the media presentation, what examples are given to illustrate the idea that technology creates both benefits and risks (or problems)?

Optional Assignment Sheet 1

2. Define each of the following terms in the context of how they are presented in the media presentation.

    a. **Consequences**

    b. **Recycling**

    c. **Pollution**

    d. **Environment**

    e. **Greenhouse effect**

    f. **Neutrality of technology**

Permission to duplicate this assignment is granted.

Evaluating the Consequences of Using Technology
Unit 6

Answers to Assignment Sheets

Answers to required assignment sheets in student edition

Assignment Sheet 1—Answers will vary. Student performance should be evaluated according to the criteria listed on the assignment sheet.

Assignment Sheet 2—Answers will vary. Student performance should be evaluated according to the criteria listed on the assignment sheet.

Answers to optional assignment sheet in teacher edition

Assignment Sheet 1

1. Students should list automobiles, mountain bikes, packaging of goods, dynamite, nuclear/atomic energy, and pesticides.

2.
   a. **Consequences**—Actions that result from other actions

   b. **Recycling**—Transforming waste products into new products

   c. **Pollution**—A reduction in the quality of the environment by the introduction of impurities

   d. **Environment**—Natural surroundings including physical, chemical, and living factors such as soil, climate, plants, and animals

   e. **Greenhouse effect**—Warming of the earth's surface and the lower layers of the atmosphere that tends to increase with increasing atmospheric carbon dioxide

   f. **Neutrality of technology**—A technology is neither good nor bad; the outcomes of using a technology are determined by how we choose to use it.

Evaluating the Consequences of Using Technology
Unit 6

Written Test

Name ______________________________ Score ______________

1. Discuss why people must evaluate their use of technology. Write your answer on the blanks provided below.

2. List two of the undesired consequences of using technology. Write your answers on the blanks provided below.

   a. ______________________________

   b. ______________________________

3. Define the term *futuring process*. Write your answer on the blanks provided beside the term below.

   Futuring process ______________________________

Permission to duplicate this test is granted.

Evaluating the Consequences of Using Technology
Unit 6

Answers to Written Test

1. People use a technology to solve a problem. When people use a technology to solve a problem, there are consequences—some consequences are anticipated and desired; other consequences are not anticipated or desired. People must evaluate both the desired and undesired consequences of using a technology and decide if the continued use of a technology is appropriate in a given situation.

2. Answers may appear in any order.
   - Negative impact on the environment
   - Negative impact on society

3. Process of projecting possible future consequences of using a technology and analyzing the possible effects of each consequence

Evaluating the Consequences of Using Technology
Unit 6

Unit Evaluation Form

Student name ____________________ Unit rating ____________

Assignment-sheet ratings

Assignment Sheet 1—Evaluate the Consequences of Your Television-Watching Habits Rating ________

Comments: ______________________________

____

____

Assignment Sheet 2—Evaluate the Consequences of Your Family's Present Recycling Habits Rating ________

Comments: ______________________________

____

____

Lab-activity-sheet rating

Lab Activity Sheet 1—Collect a Sample of the Particulate Matter in the Air Rating ________

Comments: ______________________________

____

____

List optional assignments and ratings.

Continue to back of this page.

Unit Evaluation Form

Written-test scores

Pretest __________ Posttest __________ Other __________

Comments: ____

____

____

Teacher signature ______________________________ Date ____________________

Student signature ______________________________ Date ____________________

Permission to duplicate this form is granted.

Exploring Technology Education:

Introduction to Technology Education

Student Edition

Written by

John D. Joerschke, Technical Writer

Project coordinated by

Sue Jones, Curriculum Specialist
Multistate Academic and Vocational Curriculum Consortium, Inc.

Project developed by

The Multistate Academic and Vocational Curriculum Consortium, Inc.
1500 West Seventh Avenue
Stillwater, Oklahoma 74074-4364

©1997

The Multistate Academic and Vocational Curriculum Consortium (MAVCC) does not discriminate on the basis of race, creed, color, national origin, sex, age, religion, veteran status, or qualified handicap.

Introduction to Technology Education

Student Edition

Table of Contents

Unit 1: **What Is Technology Education?** **Page**

Objective Sheet 1
Information Sheet 3
Assignment Sheet
    1—Profile the Technology Resources and Systems in Your State 7
Assignment Sheet
    2—Draw a Systems Model to Analyze an Industry, Business, or Company in Your Local Area 23
Assignment Sheet
    3—Explore the Interrelationship of the Functions of the Types of Technology Systems 27
Student Supplement
    1—Honda Overview 31

Unit 2: **Basic Laboratory Safety**

Objective Sheet 33
Information Sheet 35
Assignment Sheet
    1—Interpret Portable Fire-Extinguisher Symbols 43
Student Supplement
    1—Guidelines for Using Portable Fire Extinguishers 45
Student Supplement
    2—Extinguisher Markings for Extinguishers Suitable for Use on Class A, B, or C Fires 49
Student Supplement
    3—Extinguisher Markings Indicating Extinguishers Unsuitable for Use on Class A, B, or C Fires 51
Assignment Sheet
    2—Determine Correct Laboratory Safety Practices 53
Assignment Sheet
    3—Identify Safety Practices Followed in Your Technology Education Laboratory 63

Unit 3: **Measuring and Related Math**

Objective Sheet 65
Information Sheet 67
Assignment Sheet
    1—Add Whole Numbers 73
Assignment Sheet
    2—Subtract Whole Numbers 75
Assignment Sheet
    3—Multiply Whole Numbers 77
Student Supplement
    1—Multiplication Table 81
Assignment Sheet
    4—Divide Whole Numbers 83

Table of Contents

Unit 3: **Measuring and Related Math** (continued) **Page**

Assignment Sheet
    5—Reduce Fractions to Lowest Terms 87
Assignment Sheet
    6—Convert Mixed Numbers to Improper Fractions and Improper Fractions to Mixed Numbers 89
Assignment Sheet
    7—Add Fractions 93
Assignment Sheet
    8—Subtract Fractions 97
Assignment Sheet
    9—Add Decimal Numbers 103
Assignment Sheet
    10—Subtract Decimal Numbers 109
Assignment Sheet
    11—Multiply Decimal Numbers 113
Assignment Sheet
    12—Divide Decimal Numbers 117
Assignment Sheet
    13—Convert Fractions to Decimals 121
Assignment Sheet
    14—Read U.S. Customary and Metric Rules 127
Student Supplement
    2—Metric/U.S. Customary Decimal Equivalents for Fractional Parts of an Inch 137
Assignment Sheet
    15—Compute U.S. Customary/Metric Equivalents 139
Student Supplement
    3—Metric/U.S. Customary Conversion Table 143

Unit 4: **Thinking Skills**

Objective Sheet 145
Information Sheet 147
Assignment Sheet
    1—Use the Tools for Understanding the Creative Process to Analyze the Nature of a Recent Innovation 149
Student Supplement
    1—Tools for Understanding the Creative Process 153
Student Supplement
    2—An Example of How to Analyze the Creative Process 155
Student Supplement
    3—Creating Opportunities for Creativity 157
Assignment Sheet
    2—Use the Tools of Logical Thinking to Analyze a Situation 159
Student Supplement
    4—Tools of Logical Thinking 161
Assignment Sheet
    3—Apply the Problem-Solving Process to Improve the Quality of a Product or Service 163
Student Supplement
    5—The Problem-Solving Process 165

Table of Contents

Unit 4: **Thinking Skills** (continued) Page

Lab Activity Sheet
    1—Create and Construct a Device That Will Extinguish a Candle Flame 167
Lab Activity Sheet
    2—Create and Construct a Vessel That Will Float and Bear Weight 171

Unit 5: **Career-Exploration Process**

Objective Sheet 175
Information Sheet 177
Assignment Sheet
    1—Gather Personal Information 181
Assignment Sheet
    2—Gather General Job Information and Identify Occupational Area of Choice 191
Student Supplement
    1—Career Search Booklet 195
Assignment Sheet
    3—Gather Specific Job Information 247
Student Supplement
    2—Job-Information Report Form 251
Assignment Sheet
    4—Make a Career Decision 255
Student Supplement
    3—Job-Comparison Worksheet 257
Assignment Sheet
    5—Develop a Plan of Action to Meet Career Goal 259
Student Supplement
    4—Career Objectives 261
Student Supplement
    5—What You Can Do This Year 265
Student Supplement
    6—What You Can Do in High School 267
Student Supplement
    7—What You Can Do After High School 269
Student Supplement
    8—Career Plan of Action 271

Unit 6: **Evaluating the Consequences of Using Technology**

Objective Sheet 273
Information Sheet 275
Assignment Sheet
    1—Evaluate the Consequences of Your Television-Watching Habits 277
Assignment Sheet
    2—Evaluate the Consequences of Your Family's Present Recycling Habits 281
Student Supplement
    1—Environmental Primer 285
Lab Activity Sheet
    1—Collect a Sample of the Particulate Matter in the Air 289

What Is Technology Education?
Unit 1

Objective Sheet

Unit objective

After completing this unit, the student should be able to define *technology, technology education*, and *technology systems;* profile the technology resources in his or her state; use a systems model to analyze a local business; and explore the interrelationship of the functions of the types of technology systems. The student will demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the written test.

Specific objectives

After completing this unit, the student should be able to

1. Define the term *technology education.*
2. Define the term *technology.*
3. Define the term *system.*
4. Define the term *technology system.*
5. Match types of technology systems to their correct definitions.
6. Define the stages in a basic technology systems model.
7. List the classifications of the resources used in the various types of technology systems.
8. Discuss the interrelationship of the functions of the types of technology systems.
9. Profile the technology resources and systems in your state. (Assignment Sheet 1)
10. Draw a systems model to analyze an industry, business, or company in your local area. (Assignment Sheet 2)
11. Explore the interrelationship of the functions of the types of technology systems. (Assignment Sheet 3)

What Is Technology Education?
Unit 1

Information Sheet

1. **Definition of *technology education***—A hands-on, laboratory-based educational program that allows students to use problem-solving methods to explore the various systems of technology and the educational and career opportunities available in each system

2. **Definition of *technology***—The application of knowledge and the use of resources to meet human needs and solve problems

   Note: *Resources* are those items necessary for a system to function. See Objective 7.

3. **Definition of a *system***—Group of people, procedures, equipment, and resources that function together to produce desired results

4. **Definition of a *technology system***—A group of technologies used in combination to deliver products or services that meet demands

   Note: A *product* is a tangible commodity (something that can be touched). A *service* is work that does not produce a tangible commodity but often contributes to the welfare of others. Examples of services are the work performed by doctors, lawyers, teachers, entertainers, bankers, etc.

5. **Types of technology systems and their definitions**

   - **Communication system**—System in which information is exchanged between individuals or machines through a common system of signs, symbols, or behavior

   - **Construction system**—System in which manufactured goods and materials are used to build a structure on site

     Note: A *structure* is something made up of a number of parts that are held or put together in a particular way.

   - **Manufacturing system**—System in which materials and processes are used to produce a product that will be used elsewhere

   - **Energy, power, and transportation system**—System in which energy is converted into mechanical, fluid, or electrical power to do work

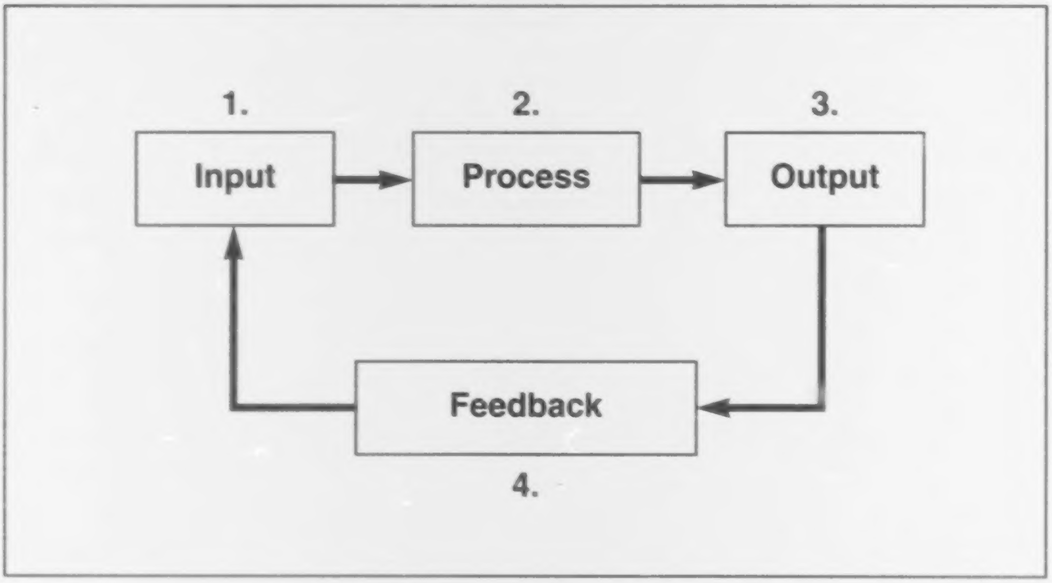
6. **Stages in a basic technology systems model and their definitions**

   Note: A *systems model* is a visual representation that analyzes the stages (input, process, output, and feedback) in a technology system. See Figure 1 and Figure 2 on the following pages.

Information Sheet

- **Stage 1: Input**—The means by which or the point at which something is put into a system
- **Stage 2: Process**—A series of actions or operations occurring in a system
- **Stage 3: Output**—Something produced by a system
- **Stage 4: Feedback**—The return to the input stage with evaluative or corrective information about the system process and output

Figure 1: Systems model



7. **Classifications of the resources used in the various types of technology systems**

Note: As was stated in Objective 2, *resources* are those items necessary for a system to function. The list below gives the broad classifications for the various types of resources that may be used in the stages of a technology system. Figure 2 shows an example of the resources used in the stages of a basic manufacturing-technology systems model.

- **People**

  Note: *People* are the individuals who design, create, and control the technology in a technology system.

- **Information**

  Note: *Information* is the data that is processed in a technology system.

- **Materials**

  Note: *Materials* are the physical substances that are used in the processes in a technology system. There are both *natural* and *synthetic* materials. Natural materials are those that exist in nature; synthetic materials are those that are created by people.

Information Sheet

- **Tools and machines**

  Note: *Tools* and *machines* are man-made devices or instruments that are used to extend the capabilities of people to process or maintain other resources in a technology system. *Hand tools* are tools that require human muscle power to make them work; *machines* are devices that change the amount, speed, and direction of a force to perform work; *electronic tools and machines* are tools or machines that are electronically (computer) controlled.

- **Energy**

  Note: *Energy* is the capacity for doing work. There are two classifications of energy—exhaustible and inexhaustible. *Exhaustible* forms of energy can be used up; *inexhaustible* forms of energy cannot be used up.

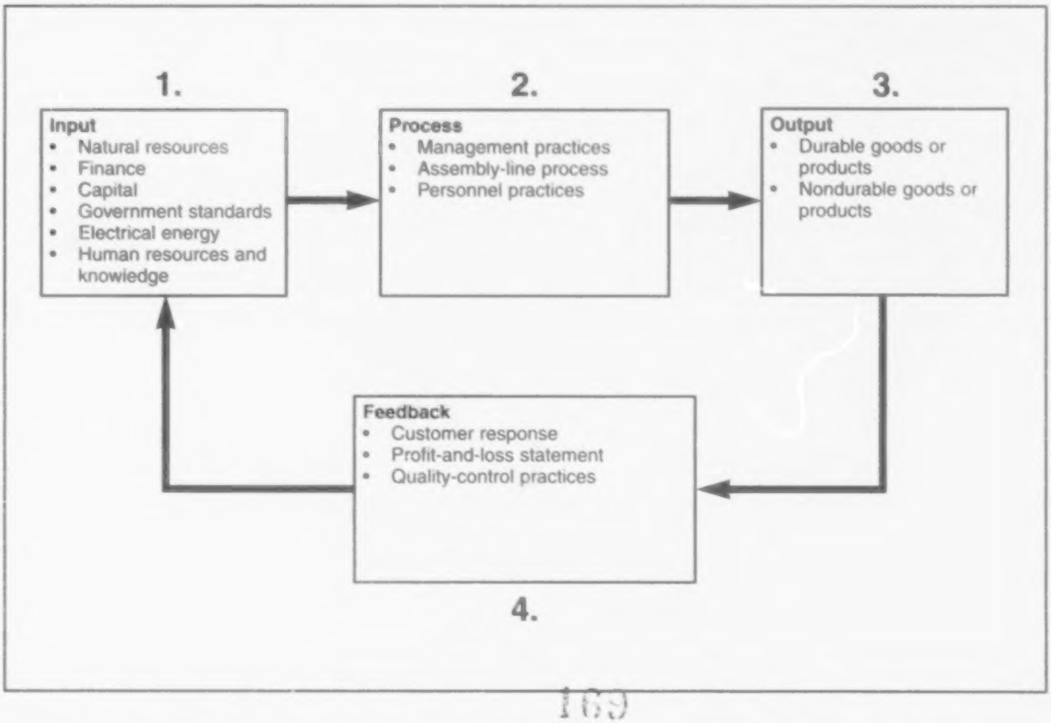
- **Capital**

  Note: *Capital* is the accumulated goods (assets) devoted to the production of other goods within a technology system and, also, the value of these accumulated goods.

- **Time**

  Note: *Time* is defined as the measured periods during which a process can occur in a technology system.

Figure 2: Example of a systems model showing the resources used in the various stages of a basic manufacturing-technology system


1.
Input
• Natural resources
• Finance
• Capital
• Government standards
• Electrical energy
• Human resources and knowledge
2.
Process
• Management practices
• Assembly-line process
• Personnel practices
3.
Output
• Durable goods or products
• Nondurable goods or products
Feedback
• Customer response
• Profit-and-loss statement
• Quality-control practices
4.

Information Sheet

8. Interrelationship of the functions of the types of technology systems

Note: Even though you will be studying the various technology systems as separate units, in the real world, all those people who work in one type of technology system depend on those working in the other types for the smooth, efficient flow of goods and services to the consumer (see Figure 3).

- **Communication**—Provides the means for the exchange of information required between manufacturing plants; construction sites; and energy, power, and transportation industries

- **Construction**—Builds structures to house manufacturing and communication enterprises; to produce, store, and transmit power; and to transport materials and products

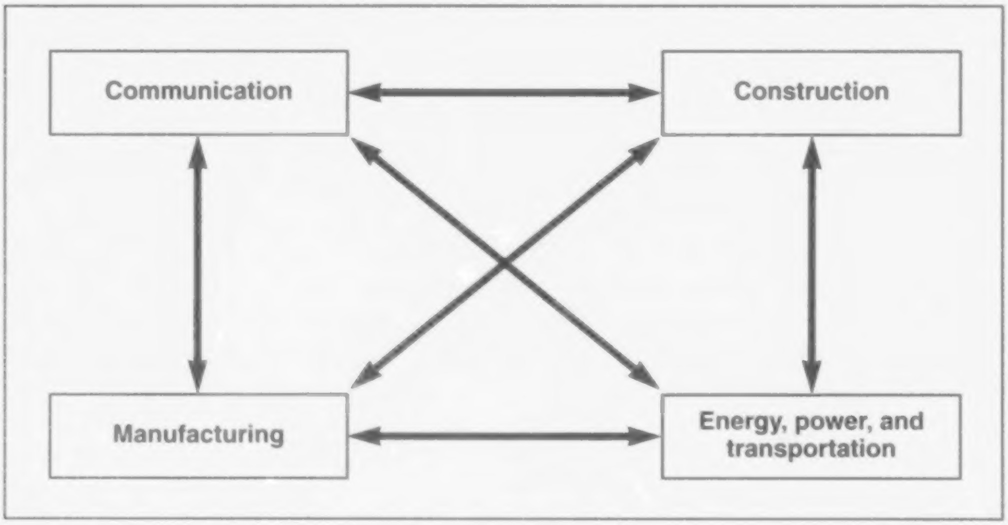
  Examples: Runways and railroads for transportation; dams to store water for producing electrical power; radio towers for communication systems

- **Manufacturing**—Produces products and processes used in communication; construction; and energy, power, and transportation

  Examples: Construction materials and equipment, computers, machines, automobiles, trucks, airplanes

- **Energy, power, and transportation**—Produces, stores, and transmits power used in manufacturing, construction, and communication; moves materials and products used by manufacturing, construction, and communication

Figure 3: Interrelationship of the technology systems



What Is Technology Education?
Unit 1

Assignment Sheet 1—Profile the Technology Resources and Systems in Your State

Name ______________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	______
Student responses are relevant and well thought out.	______
Overall rating	______

Evaluator's comments ______________________________________

____

____

Introduction

Every day, anywhere you live, your life is affected by the systems of technology. In every state, there are industries, businesses, and companies using that state's particular resources and operating within that state's particular communication; construction; manufacturing; and energy, power, and transportation systems.

A profile is a good tool to use in order to help you become aware of just how often your life is touched by technology systems. A *profile* is a set of data portraying the significant features of a region—in this case, portraying the types of technology resources and systems in your state.

This assignment asks you to complete a questionnaire as a guide in completing the research necessary to develop a resource and technology-system profile of your state. Use almanacs, encyclopedias, state periodicals, information from your local chamber of commerce and the state tourism department along with other print and computerized reference materials in your local or school library to complete the questionnaire.

Exercise

Directions

Using the various reference materials mentioned above, complete the questionnaire in Part A of the assignment to compile information for your state. Then, complete Parts B and C. Part B asks you to profile your state's particular resources, and Part C asks you to profile its technology systems. Read each part, and then, answer the questions in each part.

Part A **State questionnaire**

1. What is the area in square miles of your state?

Area ______________________________________

Assignment Sheet 1

2. What are the maximum and minimum elevations of your state?

Maximum elevation ______________________________

Minimum elevation ______________________________

3. Describe the topography (major geographic features) of your state's land mass (i.e. mountains, plains, forests, swamps, etc.).

____

____

____

____

____

4. Name your state's capital city.

Capital city ______________________________

5. List five other major cities in your state and determine how many miles they are from the state capital.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

6. Describe the climate of your state. (Does it have distinct seasons? Is it normally very dry, very wet, or more temperate with seasonal wet and dry spells? What distinct weather occurrences [heavy snows, severe thunderstorms, long periods of pleasant, sunny weather] characterize your state's climate?)

____

____

____

____

____

____

Assignment Sheet 1

7. What are the major natural resources (minerals, rich soil, fisheries, natural beauty, etc.) of your state?

____

____

____

____

____

8. In what time zone does your state lie?

Time zone ________________________________

9. What are your state's major industries as determined by dollars of annual sales? Types of American industries and examples of each are given below. Write your answers on the blank lines provided on the next page.

Mining — Coal, metals, petroleum, nonmetallic ores

Construction

- Residential — Homes
- Commercial — Office buildings, factories, public buildings, retail business buildings
- Civil — Railroads, airports, roads, bridges, pipelines, dams, tunnels

Manufacturing

- Durable goods — Lumber and wood products, furniture, glass containers, cement, concrete, iron, steel, aluminum, electrical machinery, motor vehicles, aerospace products, appliances, instruments, electronics
- Nondurable goods — Textile products, apparel, pulp, paper, printing, synthetic materials and plastics, tires, footwear, chemicals, drugs

Transportation — Railroads, automobiles, trucks, ships, airlines, aerospace

Power-generating — Electrical plants, coal, nuclear, solar, geothermal

Communication — Telephone and telegraph, electrical power, radio and TV broadcasting, movies, graphic arts, drafting, fiber optics, lasers

Services — Hotels, restaurants, insurance, banking, appliance repair, vehicle repair, wholesale trade, retail trade, education, medical care

Agriculture — Dairy, fruit, vegetable, meat, grain, cotton, tobacco

BEST COPY AVAILABLE

Assignment Sheet 1

10. What effects do climate and natural resources have on your state's major industries?

11. What are the major transportation routes (highways, railroads, air terminals, navigable waters, etc.) of your state?

Assignment Sheet 1

12. What is your state's total population? Describe how the population is distributed. (Is it predominantly urban, rural, or mixed?)

13. What is the population density (people per square mile area) of your state?

14. Is your state gaining or losing population according to the last two census reports?

15. What raw materials do your state's major industries import and export?

16. What finished products do your state's major industries import or export?

Assignment Sheet 1

17. What methods of transportation (trucks, rail, canal barge, seagoing vessels, aircraft, etc.) are used to move goods from and to your state?

18. Name the major comprehensive universities (public and private) in your state.

19. Name the specialized professional schools (medical, law, divinity, etc.) in your state.

20. Describe your state's vocational and technical training program. (Where are vo-tech schools located and how are they organized?)

Assignment Sheet 1

21. List private technical schools (aviation, business schools, etc.) in your state.

22. List major museums and art galleries in your state.

23. What is your state's annual budget?

24. What is the per-capita income for your state?

25. Does your state have an income tax? Sales tax? If so, what are/is the rate(s)?

Assignment Sheet 1

26. What are the major financial centers (cities) of your state?

27. In dollar amounts, how much of your state's economy is generated by tourism, agriculture, manufacturing, mining, fishing, and services? (List only those that apply.)

28. Does your state have any restrictive regulations that might impede trade, such as higher highway-use taxes for trucks, or higher diesel-fuel taxes than surrounding states? Describe these regulations, if any.

Assignment Sheet 1

29. Name the major public-utility firms (electrical power, natural gas, telephone, etc.) in your state.

____

____

____

____

____

____

30. Do any of the geographic considerations mentioned above play a part in the business of any of these utilities? If so, what part do they play?

____

____

____

____

____

____

31. Name the state agency charged with overseeing public utilities in your state.

____

Part B **Resource profile**

Directions As you learned in Objective 2 of the information sheet, *resources* are those items necessary for a technology system to function. The items in the box on the next page give the broad classifications of the resources that may be used in technology systems. On the blank pages that follow, analyze the information you have gained by completing the questionnaire in Part A of this assignment—write a report that profiles the particular resources that are available in your state.

Assignment Sheet 1

1. **People resources**

   People are the individuals who design, create, and control the technology in a technology system.

2. **Information resources**

   Information is the data that is processed in a technology system.

3. **Materials resources**

   Materials are the physical substances that are used in the processes in a technology system. There are both *natural* and *synthetic* materials. Natural materials are those that exist in nature; synthetic materials are those that are created by people.

4. **Tools and machines**

   Tools and *machines* are man-made devices or instruments that are used to extend the capabilities of people to process or maintain other resources in a technology system. *Hand tools* are tools that require human muscle power to make them work; *machines* are devices that change the amount, speed, and direction of a force to perform work; *electronic tools and machines* are tools or machines that are electronically controlled.

5. **Energy**

   Energy is the capacity for doing work. There are two classifications of energy—exhaustible and inexhaustible. *Exhaustible* forms of energy can be used up; *inexhaustible* forms of energy cannot be used up.

6. **Capital**

   Capital is the accumulated goods devoted to the production of other goods and, also, the value of these accumulated goods.

7. **Time**

   Time is defined as the measured periods during which a process can occur in a technology system.

Resource profile

Assignment Sheet 1

Resource profile (cont.)

Assignment Sheet 1

Part C **Technology-systems profile**

Directions In Objective 5 of the information sheet, you studied the different types of technology systems: communication; construction; manufacturing; and energy, power, and transportation.

By filling out the questionnaire in Part A of this assignment, you have learned the particular types of industries, businesses, and companies that function in your state.

Listed below are the systems of technology. From your research, list the names and addresses of four specific industries, businesses, or companies that are examples of each technology system listed below. List industries, businesses, or companies in your state that are located as closely as possible to the town or city in which you reside.

1. **Communication system**

   a. Name and address of industry/business/company

   ____

   ____

   ____

   ____

   b. Name and address of industry/business/company

   ____

   ____

   ____

   ____

   c. Name and address of industry/business/company

   ____

   ____

   ____

   ____

Assignment Sheet 1

d. Name and address of industry/business/company

____

____

____

____

2. **Construction system**

a. Name and address of industry/business/company

____

____

____

____

b. Name and address of industry/business/company

____

____

____

____

c. Name and address of industry/business/company

____

____

____

____

d. Name and address of industry/business/company

____

____

____

____

Assignment Sheet 1

3. Manufacturing

a. Name and address of industry/business/company

b. Name and address of industry/business/company

c. Name and address of industry/business/company

d. Name and address of industry/business/company

4. Energy, power, and transportation

a. Name and address of industry/business/company

Assignment Sheet 1

b. Name and address of industry/business/company

____

____

____

____

c. Name and address of industry/business/company

____

____

____

____

d. Name and address of industry/business/company

____

____

____

____

What Is Technology Education?
Unit 1

Assignment Sheet 2—Draw a Systems Model to Analyze an Industry, Business, or Company in Your Local Area

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	_____
Student responses in Part A are relevant and well thought out.	_____
Systems model in Part B is neat, attractive, and well organized visually.	_____
Overall rating	_____

Evaluator's comments ____

____

____

Introduction

In Objective 6 in the information sheet, you learned that a *systems model* is a visual representation that analyzes the stages (input, process, output, and feedback) in a technology system. And, in Figure 2, you were given an example of a systems model for a manufacturing-technology system.

In Assignment Sheet 1, you obtained the names and addresses of several industries, businesses, and companies operating in your area of the state.

To gain further insight into how technology systems touch your daily life, this exercise leads you through an interview with an officer of one of the firms you have listed in Assignment Sheet 1.

Exercise

Directions

Review the information in Objectives 6 and 7 of the information sheet.

Following the instructions given by your instructor, you are to interview a businessperson in your local area to find the answers to the questions listed in Part A.

In Part B of this assignment, you are to take the information you obtained in the interview and draw a systems model of the industry/busi-ness/company that employs the person you interviewed.

Part A **Interview questionnaire**

Directions

Show the person you are to interview the system models in Figures 1 and 2 in Objectives 6 and 7 in the information sheet of this unit, and then, have him or her help you answer the questions on the next pages.

Assignment Sheet 2

Name/title of person interviewed ______________________________

Name of industry/business/company ______________________________

1. **Output:** What products/services does your company produce/provide?

2. **Input:** What resources are needed at the input stage to produce/provide the products/services your company supplies?

3. **Process:** What resources are used during the series of actions or operations occurring to produce/provide the products/services your company supplies?

Assignment Sheet 2

4. **Feedback:** What forms of evaluative or corrective information provide feedback about the system processes used by your company or about the products/services your company supplies?

Part B **Systems model**

Directions Review the information you obtained in the interview you conducted in Part A of this assignment. Then, in the space below or on another sheet of paper, draw a systems model of the industry/business/company you researched. Use the example in Figure 2 in Objective 7 of the information sheet as a model in creating your systems model for the firm you researched.

What Is Technology Education?
Unit 1

Assignment Sheet 3—Explore the Interrelationship of the Functions of the Types of Technology Systems

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	______
Student responses in Part A are relevant, well thought out, and clearly explain the interrelationship of the technology systems.	______
Poster completed in Part B is neat, attractive, and well organized visually and clearly explains the interrelationship of the technology systems.	______
Overall rating	______

Evaluator's comments ____

____

____

Introduction Thus far in this unit, you have studied the types of technology systems (Objective 5 in the information sheet) and the classifications of the resources used in the various types of technology systems (Objective 7). You have also studied in a general way (in Objective 8) the interrelationship of the functions of the types of technology systems. Now, you should be able to successfully explore the worker interrelationships in a specific way.

Exercise

Part A **Describe the interrelationship of the various workers involved in producing and delivering Hondas.**

Directions Read Student Supplement 1, "Honda Overview," beginning on page 31 and then, on this and the following pages, you will write a description of how you believe the various workers in the various technology systems might have cooperated to complete their mission—producing and delivering Hondas to American consumers.

Honda description

____

____

____

____

Assignment Sheet 3

Honda description (cont.)

Assignment Sheet 3

Honda description (cont.)

Assignment Sheet 3

Part B **Prepare a poster illustrating the interrelationship of the workers involved in producing a commonplace product.**

Introduction We often think of technology systems only in relation to highly technical products such as spacecraft and computers while we take for granted the products that we use every day. Technology isn't limited to spacecraft and computers.

Directions Choose a commonplace product that you use in your every-day life. Pick something such as Velcro, zippers, your favorite athletic shoes, felt-tipped pens, or one of the other products listed below.

Have your instructor approve the product you have selected, and then, research it, and prepare a poster explaining the interrelationship of the workers in the various technology systems in producing and delivering this product to the consumer.

To prepare your poster, you may use your original artwork, computer-generated artwork, or pictures cut out of old magazines or newspapers.

Product list

- Sports equipment

  In-line skates
  Bicycle helmet
  Metal baseball bat
  Tennis ball
  Basketball shoes

- Tools

  Pencil
  Rolling pin
  Scissors
  Sandpaper
  Potato peeler
  Toothbrush
  Non-stick cookware

- Clothing and accessories

  Velcro
  Knit cotton sweaters
  Zippers
  Hiking boots
  Stretchable fabrics
  Cowboy hats

- Other

  Books
  Fever thermometer
  Safety pins
  Adhesive bandages
  Eyeglasses

What Is Technology Education?
Unit 1

Student Supplement 1—Honda Overview

Most everyone is familiar with the Honda Accord, a product which at one time was produced only in Japan and shipped in great numbers across the Pacific Ocean to ports in Washington and California for further shipment across the United States. Now, however, in addition to the Japanese production of the Accord, Honda operates its own assembly plant in Marysville, Ohio, where U.S. workers build a significant number of the Accords sold in the U.S.

At one time, Honda capitalized on the fact its Accord was made in Japan, where many U.S. car buyers felt construction know-how and quality was far superior to anything available in the U.S. Faced with growing resentment in the U.S. about the overall imbalance in trade between the U.S. and Japan, however, Honda now advertises its "American made" Accords as domestic products for domestic consumers.

Overall, the Accord is one of the most popular automobiles ever produced and a standard fixture on U.S. highways. It is not difficult to find a Honda dealership, and if you watch television, you probably cannot sit through an evening of viewing without seeing a Honda commercial. So, how does a product that was originally only an idea in the mind of an engineer thousands of miles away get to be so commonplace in the U.S.? It takes thousands of workers, both Japanese and American, working toward the same goal—producing and delivering Hondas to American consumers.

From mechanical and electrical engineers in Japan and their support staff of secretaries, financial and accounting personnel, human-resource managers, building custodians, security staff, departmental managers, material handlers, steel-mill workers, inspectors, and assembly-line staff, literally thousands of workers are involved in producing the final product. Each individual must successfully do his or her job, or the final product suffers in some way—either in construction and design quality, or maybe it just does not roll off the assembly line when it is needed to fill an order.

Once the new cars are produced, they must be transported efficiently to and loaded on a waiting oceangoing freighter—for those made in Japan. (For those made in Ohio, trucks and railroad trains move them on to their final destination.) There is paperwork to be filed on each automobile and financial arrangements to be completed for the entire shipment. Just the clerical work and banking arrangements alone require hundreds of employees. Longshore workers, crane operators, and deck hands see that the cars are secured in the ship for the long trip to Seattle or San Francisco. Upon arrival, other longshore workers unload the cars and see that they are available for loading on transport trucks and railroad cars.

After truck drivers and train crews deliver the new Hondas to their regional destinations, still other truckers are waiting to haul the cars to individual dealerships. At each stop, there are warehouse and various other support personnel employed to support the people and machines required to move the new automobiles.

At the Honda dealership, there are salespeople, mechanics, secretaries, accountants, and office and shop administrators. Many dealerships will also employ credit managers for financing the sale of the new Hondas to eager new-car buyers.

How did the buyers learn of the Hondas? Remember the late-night car commercials on television? Lots of people in advertising agencies have their jobs because of Honda dollars being spent to promote Hondas to American drivers.

Student Supplement 1

What about when a Honda breaks and requires new parts? There is an entire industry—similar to that of producing the cars themselves—built around parts supply to Honda dealerships and independent parts firms that handle Honda parts. All require material handlers, clerical workers, parts specialists, transportation people, financial and accounting workers, etc.

This overview highlights various workers cooperating to bring Hondas from the assembly line to U.S. buyers. U.S. producers have similar staffs producing automobiles for sale in other countries, too. Currently, Chrysler Corporation and Ford Motor Company are both enjoying a booming demand for their sport utility vehicles in Japan, so the entire process is reversed—with similar staffs employed by Ford and Chrysler.

Similar examples could be written about any product. Designer jeans, tape and compact-disc players, food products, appliances, sporting equipment, and cameras all are good examples of products that move across national borders and in doing so, employ large numbers of people.

Basic Laboratory Safety
Unit 2

Objective Sheet

Unit objective

After completing this unit, the student should be able to apply basic laboratory safety skills. The student will demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 100 percent on the written test.

Specific objectives

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with laboratory safety.
2. State applications for the colors used in the federal safety color code.
3. Correct false statements about general laboratory safety rules.
4. Complete guidelines for maintaining a safe work area.
5. Correct false statements about guidelines for dressing safely in the laboratory.
6. List guidelines for preventing slips, trips, and falls.
7. List guidelines for preventing electrical shock.
8. List guidelines for preventing fire and fire spread.
9. Complete guidelines for using flammable materials and toxic substances.
10. Complete general guidelines for using laboratory tools and power equipment.
11. List in order the general steps for handling any emergency situation.
12. Interpret portable fire-extinguisher symbols. (Assignment Sheet 1)
13. Determine correct laboratory safety practices. (Assignment Sheet 2)
14. Identify safety practices followed in your technology education laboratory. (Assignment Sheet 3)

Basic Laboratory Safety
Unit 2

Information Sheet

1. **Terms and definitions associated with laboratory safety**

   - **Accident**—Suddenly occurring, unintentional event that causes injury or property damage
   - **Carelessness**—Failure to think before one acts; failure to pay attention
   - **Combustible**—Capable of bursting into flames at temperatures below 100°F
   - **Extinguish**—To put out a fire; to cause to cease burning
   - **Flammable**—Capable of being easily ignited and burning quickly at temperatures below 100°F

     Note: *Inflammable* means "flammable."
   - **Ground**—Electrical connection to an object that conducts electrical current to the earth
   - **Hazard**—Potential source of danger
   - **Hazardous material**—Any cancer-causing, corrosive, toxic, irritant, sensitizer, or material that has or has the potential for damaging effects on specific body organs

     Examples: Petroleum products, paints, cleaning agents, paint removers, carbon monoxide from equipment exhausts
   - **Safety**—Freedom from danger, risk, or injury

2. **Applications for the colors used in the federal safety color code**

   Note: The federal safety color-code system was put into effect so that dangers and safety equipment could be easily identified by anyone familiar with the code—even if he or she sees the colors in a place where he or she has never been before.

   - **Federal safety red**
     - Indicates danger
     - Identifies fire-protection equipment and its location
     - Identifies emergency fire exits
     - Identifies portable containers of flammable liquids
     - Identifies emergency stop bars, stop buttons, and electrical stop switches on machinery

Information Sheet

- **Federal safety yellow**
  - Indicates caution and marks physical hazards

    Examples: Low beams, steps, pits—hazardous areas that may cause stumbling, falling, or tripping
  - Indicates waste containers for explosive or combustible materials
  - Indicates equipment that should **not** be started, used, or moved

    Examples: Defective equipment, equipment being serviced
  - Identifies the starting point or power source for machinery
- **Federal safety orange**
  - Identifies dangerous parts of equipment that could cut, crush, shock, or otherwise injure
  - Indicates safety starter buttons
- **Federal safety blue**
  - Identifies tags that indicate equipment that should **not** be started, used, or moved

    Examples: Defective equipment, equipment being serviced

    Note: A blue tag is lettered with the words "Out of Order."
- **Federal safety black and white**
  - Indicate traffic-flow paths
  - Indicate storage areas
  - Identify housekeeping equipment
- **Federal safety green**
  - Identifies safety equipment other than fire-fighting equipment and its location
  - Identifies first-aid equipment and its location
  - Is applied to non-critical parts of equipment and machined surfaces, name plates, and bearing surfaces

3. **General laboratory safety rules**

- Do **not** work in the laboratory without the supervision of your instructor.
- Know the correct emergency telephone numbers for your area; make sure that they are posted near the telephone.

  Examples: Fire and police departments, ambulance service, poison-control center

Information Sheet

- Be alert for dangers and hazards.
- Walk—**never** run—in the lab.
- Be familiar with the location of fire-fighting and first-aid equipment.
- Be aware of where others are in the lab and of what they are doing.
- Stay in your assigned area of the lab.
- Conduct yourself in a safe manner; do **not** participate in horseplay in the laboratory.

  Note: **Never** clown around, play practical jokes, or try to distract other students working in the lab.
- Wear protective clothing and equipment as appropriate.

  Examples: Eye protection when using electric tools such as drills; facemask when painting; rubber gloves when using parts-cleaning solution; ear protection when running power equipment; face shields when welding

Caution: Always wear eye protection while performing the following operations:

- **Grinding, chipping, or drilling**
- **Working under equipment**
- **Operating abrasive discs**
- **Using caustic cleaning compounds**
- **Welding**

- Use and store potentially hazardous materials and products strictly according to the label instructions and cautions.
- Do **not** operate equipment if you are over-tired or ill.

  Note: If you are over-tired or ill, you will be more accident-prone, especially if you are affected by medication.
- Follow all safety guidelines set by your instructor.
- Report all hazards to your instructor.
- Report all accidents to your instructor—no matter how minor the accident may seem.
- Think safety and security for yourself and for the other students in your class.

4. Guidelines for maintaining a safe work area

- Arrange equipment to allow safe working practices and ease of cleaning.
- Store materials and supplies safely in their proper places.
- Store tools and accessories safely in suitable storage containers or areas.

Information Sheet

- Keep the work area organized and clear of debris and other hazards.
- Dispose of combustible materials properly.

  Examples: Gasoline, oil, grease, parts-cleaning solution

  Note: Do **not** pour oil, gasoline, grease, cleaning solution, or other combustible materials on the ground or down a drain. Consult your instructor regarding local ordinances for disposal of these materials.
- Keep enough brooms, brushes, waste containers, and housekeeping supplies on hand to keep the work area clean.
- Close your work area at the end of each class period by clearing away scrap materials and replacing tools and materials in their proper storage areas.

  Note: A neat and orderly lab helps you avoid accidents by reducing unsafe working conditions.

5. **Guidelines for dressing safely in the laboratory**

- Confine long hair before using power equipment or working around any machinery with moving parts.

  Examples: Running engines, moving belts, air wrenches
- Wear well-fitting, comfortable, laced shoes, and tie laces securely.
- Remove rings and other jewelry before entering the lab.
- Wear close-fitting clothing appropriate for the work being done.

  Note: Appropriate clothing is neither too tight nor too loose.
- Wear protective clothing and equipment as appropriate.

  Examples: Leather or rubber gloves, aprons, steel-toed work shoes on construction sites, eye protection, ear protection, protective head gear
- Do **not** carry tools or sharp objects in your pockets.

6. **Guidelines for preventing slips, trips, and falls**

- Wipe up spills immediately.
- Post warning signs when floors are wet.
- Report any tripping hazard.

  Examples: Loose boards, loose tiles, broken steps, torn flooring
- Do **not** leave equipment, materials, or other obstacles in traffic areas, before doors and exits, or in any other area where people may trip over them.
- Do **not** stretch extension cords across traffic areas.

Information Sheet

7. Guidelines for preventing electrical shock

- Be sure that an electrical outlet is grounded before plugging in an electrical cord.
- Do **not** use electrical equipment with worn or frayed electrical cords.
- Immediately report to your instructor all defective equipment and worn or frayed electrical cords.
- Avoid using extension cords and overloading outlets.
- Do **not** handle electrical equipment when your hands are wet, and do **not** use electrical equipment near water.
- Unplug electrical equipment before cleaning, repairing, or changing accessories.
- Know the location of the main power switch in case electrical power must be turned off in an emergency.

8. Guidelines for preventing fire and fire spread

- Do **not** let trash accumulate in storage areas.
- Store flammable and combustible materials only in approved containers and cabinets.

  Example: Store oily rags in self-closing or spring-lid metal containers.

- Keep fire doors closed, unlocked, and unblocked.

  Note: Interior fire doors serve a vital purpose—containing a fire in the area of origin.

- Know the locations of fire extinguishers, fire alarms, and emergency exits.
- Do **not** block aisles or accesses to fire alarms, extinguishers, or emergency exits.
- Notify your instructor *immediately* if a fire—no matter how small—is detected.

Caution: Fight fires only if they are very small and not too smoky. Even small fires can give off intense, toxic smoke. If the fire is large or smoky, *immediately* activate the fire alarm and initiate evacuation procedures.

- Know how to use fire extinguishers.

9. Guidelines for using flammable materials and toxic substances

- Carefully read and follow the label directions for flammable liquids and toxic substances.
- Avoid breathing fumes from flammable liquids and toxic substances; use only in well-ventilated area.

Information Sheet

- Be sure that flammable liquids and toxic substances are properly marked and stored.

  Note: Keep flammable liquids and toxic substances in their original containers or properly marked, approved containers.

- Have at the work area only the amount of flammable liquid or toxic substance needed for the job being done.

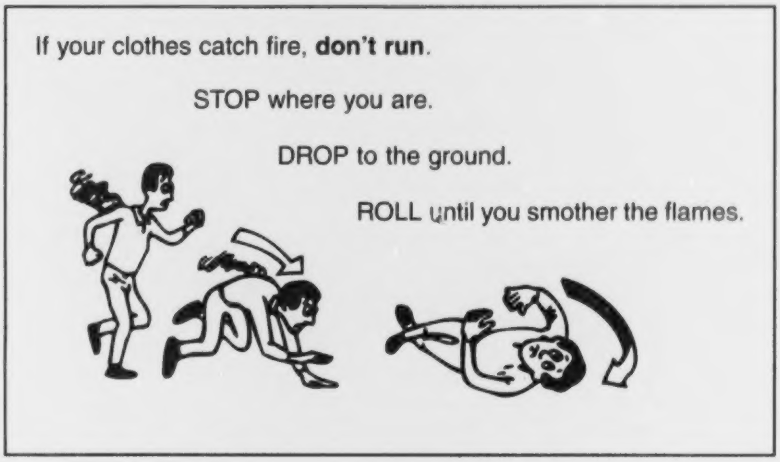
- *Immediately* change clothing on which flammable materials or toxic substances have been spilled.

- Use flammable liquids and toxic substances only for their intended purposes.

  Example: **Never** use gasoline as a cleaner.

- If your hair or clothing catches fire, do **not** run; stop, drop, and roll to smother the fire, using a blanket if available (Figure 1).

Figure 1



If your clothes catch fire, **don't run**.

STOP where you are.

DROP to the ground.

ROLL until you smother the flames.

- Do **not** use flammable materials near a fire or flame.

- **Never** put fuel into a fuel tank when the engine is running.

- Do **not** operate equipment with a fuel leak.

10. **General guidelines for using laboratory tools and power equipment**

- Obtain your instructor's approval before operating any power equipment.

- Operate a tool or machine only after receiving training on how to use it properly and safely.

- Obey all safety rules and operating instructions provided by the tool or machine manufacturer, plus any additional ones required by your instructor in your lab.

- Keep tools and machines clean and in good working order.

Information Sheet

- Properly store tools and machines when not in use.
- Keep guards and safety devices in place on all tools and machines.
- Immediately tag and report to your instructor any defective power tools or machines.
- Turn off power tools and machines when not in use.
- Use the correct tool for the job to be done.
- **Never** use compressed air to clean yourself or your clothing; do **not** direct compressed air toward another person.
- If you are **not** going to use a piece of equipment, **leave it alone**.

  Note: Only one student at a time may operate a piece of equipment. Do **not** start a machine for another student, and do **not** stop a machine for another student except in an emergency.

- Do **not** lean on any of the machines in the lab.

  Note: If you lean on a machine, you could accidentally press a switch or throw a control that could endanger you or another student operating the machine.

- **Never** throw tools or materials in the lab.

11. General steps for handling any emergency situation

- **Step 1:** Determine the type of emergency.
- **Step 2:** Notify the appropriate medical or law-enforcement authority.

  Examples: Ambulance, fire department, police

- **Step 3:** Notify your instructor.
- **Step 4:** Provide basic first aid **if** you have been properly trained, or seek assistance from others until the proper authorities arrive.

Basic Laboratory Safety
Unit 2

Assignment Sheet 1—Interpret Portable Fire-Extinguisher Symbols

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	______
All questions have been answered correctly.	______
Overall rating	______

Evaluator's comments ______________________________

____

____

Introduction When a fire occurs, it is very important not only to be able to size up and identify the type of fire, but also to choose an extinguisher that will be effective in putting out the fire.

Exercise

Directions Review the material presented in Objective 8 of the information sheet, and locate and study the information presented in Student Supplements 1 through 3, beginning on page 45.

Next, read and follow the directions with each item below.

1. Match extinguisher picture symbols with the extinguisher's intended applications. Write the correct numbers on the blanks.

______ a. Class A and B fires but not Class C fires

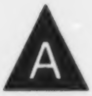
______ b. Flammable liquids

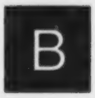
______ c. Class B and C fires but not Class A fires

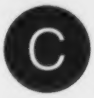
______ d. Ordinary combustibles

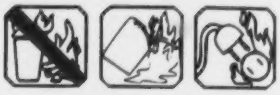
______ e. Class A fires but not Class B and C fires

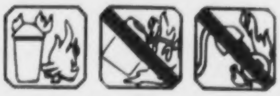
______ f. Electrical equipment

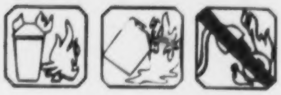
1. 

2. 

3. 

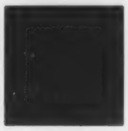
4. 

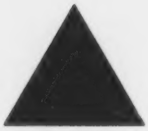
5. 

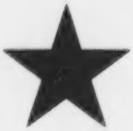
6. 

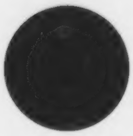
Assignment Sheet 1

2. Write on the blank the correct fire-class letter that would appear in the center of each of the following extinguisher symbol shapes. Below each shape, write the color associated with the shape.

______ a. 

______ b. 

______ c. 

______ d. 

3. Complete the fire-extinguisher general operating instructions that follow the letters P-A-S-S.

a. **P** ________________________________

b. **A** ________________________________

c. **S** ________________________________

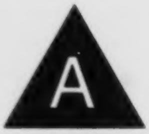
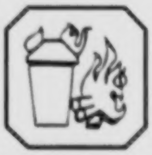
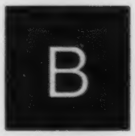
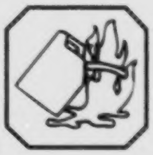
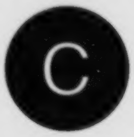
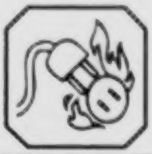
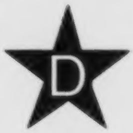
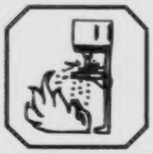
d. **S** ________________________________

Basic Laboratory Safety
Unit 2

Student Supplement 1—Guidelines for Using Portable Fire Extinguishers

All portable fire extinguishers are labeled with picture and shape symbols. Each of the shape symbols (triangle, square, circle, and star) contains the letter of the fire class for which the extinguisher is effective. The picture symbols not only illustrate what type(s) of fire the extinguisher may be used on, but also tell what class(es) of fire the extinguisher should **not** be used on. All of this information, as well as directions for using the extinguisher, are also printed on the extinguisher. However, when a fire is discovered, speed is important, and as the saying goes, "a picture is worth a thousand words." You should learn to be able to glance at the symbols on an extinguisher and know immediately whether the extinguisher is appropriate for the fire on hand.

Below are examples of fire-class shape symbols and their meanings, and examples of extinguisher picture symbols and their meanings.

 (Green) **Class A** • Ordinary combustibles (paper, wood, rags, rubber, plastics) 	 (Red) **Class B** • Flammable liquids and gases (gasoline, oil, grease, paint, solvent) 
 (Blue) **Class C** • Live electrical equipment (motors, switchboards, computers, electrical wiring) 	 (Yellow) **Class D** • Combustible metals (iron, magnesium, sodium, potassium) 

Student Supplement 1

Using a portable fire extinguisher properly requires more than simple manipulation. You must always size up the fire and decide whether it can be extinguished with an extinguisher. If the fire is too large or too smoky, call the fire department. If the fire is small enough to be extinguished with an extinguisher, use the following steps to fight the fire, and remember to always fight it with your back to a means of escape.

1. Pick up the fire extinguisher by its handle.

   Note: *All* modern fire extinguishers are designed to be used in an *upright* position.

2. Read the fire-extinguisher label to determine proper stream reach.

   Note: *Stream reach* is the distance the extinguishing agent is propelled. Stream reach varies with each extinguisher, and may range from 3 to over 20 feet. Normally, the smaller the extinguisher, the shorter the stream reach.

3. Walk—do **not** run—to within stream reach of the fire.

4. **Pull** the pin at the top of the extinguisher that keeps the handle from being pressed.

   Note: Pulling the pin automatically breaks the plastic or thin-wire inspection band.

5. Release the nozzle from its clip, if applicable.

6. **Aim** the nozzle at the base of the fire.

7. **Squeeze** the discharge handle (above the carrying handle) to release the extinguishing agent.

8. **Sweep** the nozzle back and forth at the base of the flames.

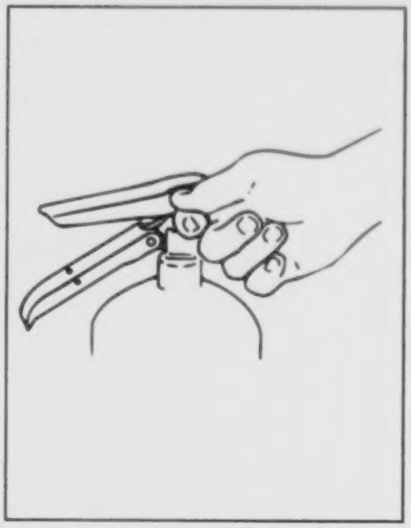
9. After the fire appears to be out, probe for remaining hot spots.

10. Make sure the fire is out by extinguishing any hot spots.

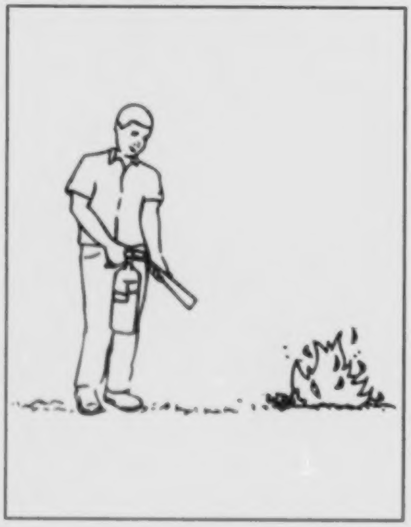
Student Supplement 1

Remember the **P-A-S-S** sequence when using a portable fire extinguisher.

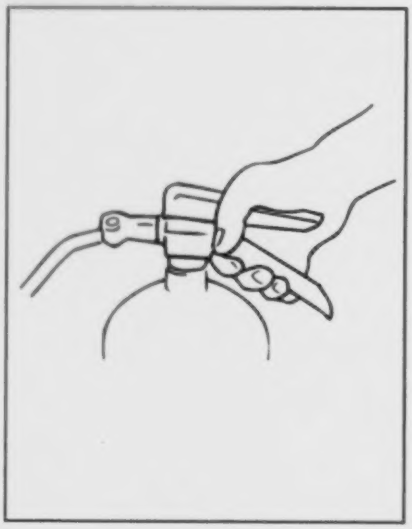
1. **P**ull the pin.



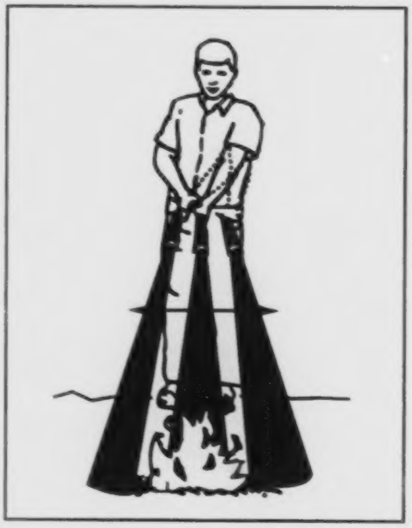
2. **A**im the nozzle at the base of the fire.



3. **S**queeze the handle.

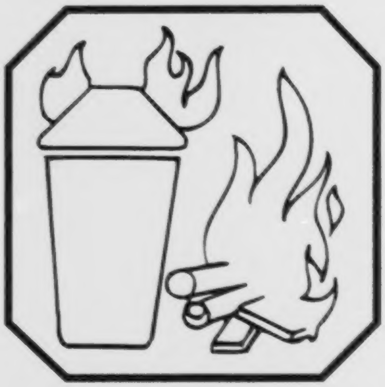
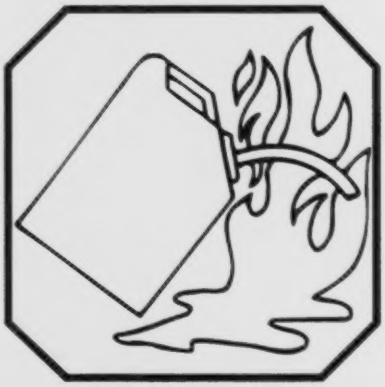
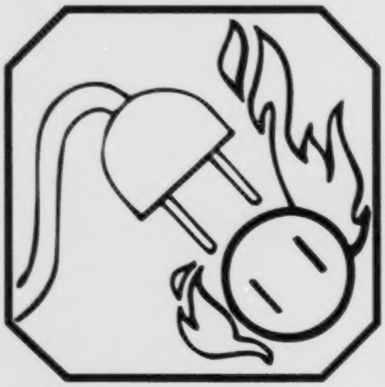


4. **S**weep the nozzle.



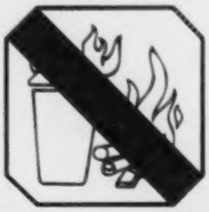
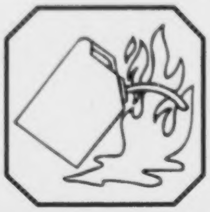
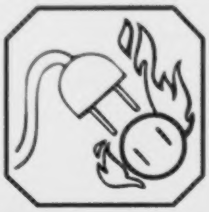
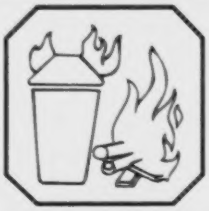
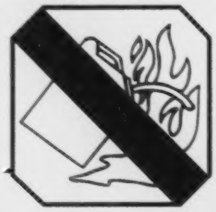
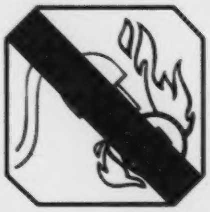
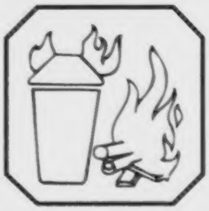
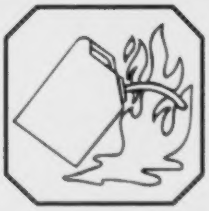
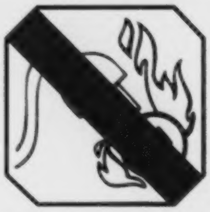
Basic Laboratory Safety
Unit 2

Student Supplement 2—Extinguisher Markings for Extinguishers Suitable for Use on Class A, B, or C Fires

Ordinary A combustibles (green)	
Flammable B liquids (red)	
Electrical C equipment (blue)	

Basic Laboratory Safety
Unit 2

Student Supplement 3—Extinguisher Markings Indicating Extinguishers Unsuitable for Use on Class A, B, or C Fires

			Picture symbols for extinguishers suitable for Class B and C fires, but **not** for Class A fires.
			Picture symbols for extinguishers suitable for Class A fires, but **not** for Class B and C fires.
			Picture symbols for extinguishers suitable for Class A and B fires, but **not** for Class C fires.

Basic Laboratory Safety
Unit 2

Assignment Sheet 2—Determine Correct Laboratory Safety Practices

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	_______
All questions have been answered correctly.	_______
Overall rating	_______

Evaluator's comments ____

____

____

Introduction Developing good safety habits is very important for all. Working safely is good sense.

Exercise

Part A **Complete objective test**

Directions Review Objectives 2 through 11 in the information sheet, complete Assignment Sheet 1, and then, read each of the following questions. Choose the item that best answers each question. Write the letter of that item on the blank provided.

_______ 1. Which of the following is a general laboratory safety rule concerning proper laboratory conduct?

a. Be relaxed and conduct yourself in as professional a manner as possible.
b. Conduct yourself in a safe manner.
c. Continue horseplay only when the instructor's back is turned.
d. Be impatient and impolite to classmates.

_______ 2. To whom do you report *all* accidents—no matter how minor the accident may seem?

a. Your instructor
b. The school nurse
c. The school superintendent
d. Your lawyer

Assignment Sheet 2

_______ 3. Which of the following rule(s) is **not** considered a laboratory dress safety rule?

   a. Wear close-fitting clothing appropriate for the work being done.
   b. Confine long hair before using power equipment or working around any machinery with moving parts.
   c. Wear protective clothing and equipment as appropriate.
   d. Carry tools and sharp objects in your pocket.

_______ 4. Which of the following is **not** a proper use of compressed air?

   a. Using compressed air to clean yourself or your clothing
   b. Directing compressed air toward another person
   c. Neither a nor b
   d. Both a and b

_______ 5. Which of the following is a safety rule pertaining to proper laboratory-tool use?

   a. Keep tools and machines clean and in good working order.
   b. Properly store tools and machines when not in use.
   c. Neither a nor b
   d. Both a and b

_______ 6. Which of the following rules should be applied when you are operating laboratory tools and machines?

   a. Only obey those safety rules and operating instructions provided by your instructor.
   b. Only obey those safety rules and operating instructions provided by the equipment manufacturer.
   c. Only obey those safety rules and operating instructions posted near the tool or equipment.
   d. Obey all safety rules and operating instructions provided by the tool or machine manufacturer, plus any additional ones required by your instructor in your lab.

_______ 7. Which of the following rules should be followed if your hair or clothing should catch fire?

   a. Scream "fire," run to a fellow student, and drop and roll to allow him or her to smother the fire with a blanket.
   b. Do **not** run; stop, drop, and roll to smother the fire, using a blanket if available.
   c. Run to your instructor and have him or her spray water on you.
   d. None of the above

Assignment Sheet 2

_____ 8. Which of the following rules should be applied when you are using laboratory tools and machines that require guards or safety devices?

a. Use guards and safety devices only when the instructor is watching.
b. Use guards and safety devices only when you are not wearing protective eyewear and clothing.
c. Keep guards and safety devices in place on all tools and machines.
d. Remove guards and safety devices only when the procedure you are performing requires their removal.

_____ 9. Which of the following rules does **not** apply to the proper maintenance of a safe work area?

a. Store materials and supplies safely in their proper places.
b. Arrange equipment to allow safe working practices and ease of cleaning.
c. Close your work area at the end of each work week by clearing away scrap materials and replacing tools and materials in their proper storage areas.
d. Store tools and accessories safely in suitable storage containers or areas.

_____ 10. Which of the following statements is the general safety rule regarding awareness in the laboratory?

a. Be aware of your work only; do not worry about the jobs others are performing around you.
b. Be aware of where your instructor is so that you can practice safety when he or she is looking.
c. Be aware of where others are in the lab and of what they are doing.
d. None of the above

_____ 11. Which of the following statements pertains to proper dress in the laboratory?

a. Rings are allowed, but necklaces that might dangle into moving equipment parts should be removed before you go into the lab.
b. Jewelry may be worn in the lab as long as you are not working with equipment with moving parts.
c. Remove rings and other jewelry before entering the lab.
d. Remove all jewelry just before using equipment in the lab.

Assignment Sheet 2

_______ 12. Which of the following rules apply to proper laboratory dress?

a. Wear well-fitting, comfortable, laced shoes, and tie laces securely.
b. Wear protective clothing and equipment as appropriate.
c. Both a and b
d. Neither a nor b

_______ 13. Which of the following is the safety rule you should follow when you find that a tool, machine, or piece of equipment is defective?

a. Do not use the defective item; return it to the tool room immediately.
b. Continue using the equipment but report the defect to your instructor as soon as possible.
c. Leave the defective item as it is so that your instructor will not think you might have broken it.
d. Immediately tag the defective item and report it to your instructor.

_______ 14. Which of the following is **not** a proper color-coding use for federal safety yellow?

a. Indicating caution
b. Marking physical hazards
c. Identifying the starting point or power source of machinery
d. Identifying dangerous parts of equipment that could cut, crush, shock, or otherwise injure

_______ 15. Which of the following statements is the first thing you should do before using any flammable material or toxic substance?

a. Ask whether or not any classmate has ever used the material or substance and then carefully follow their instructions for use.
b. Put on rubber gloves if you know the material or substance contains acid.
c. Assume that your instructor will give you any instructions for use that will be important to your safety.
d. Carefully read and follow label directions for flammable liquids and toxic substances.

Assignment Sheet 2

_______ 16. Which of the following rules should **not** be applied when you are working with flammable materials or toxic substances?

a. Use flammable liquids and toxic substances only in a well-ventilated area.
b. Be extremely careful when using a flammable liquid or toxic substance near a fire or flame.
c. Have at your work area only the amount of flammable liquid or toxic substance needed for the job being done.
d. Avoid breathing fumes from flammable liquids and toxic substances.

_______ 17. While using power equipment, a student caught her long, loose hair in the moving belts of the engine. What safety rule(s) was **not** followed in this situation?

a. Confine long hair before working around any machinery with moving parts.
b. Avoid using power equipment.
c. Both a and b
d. Neither a nor b

_______ 18. After changing the oil on a piece of power equipment, a student was on his way to pour the used oil into a trash can when he spilled a portion of the oil on the floor. As the student walked back to his work station after pouring the oil in the trash can, he slipped and fell on the oil that he had spilled. What safety rule(s) was **not** followed in this situation?

a. Wipe up spills immediately.
b. Store flammable and combustible materials only in approved containers.
c. Both a and b
d. Neither a nor b

_______ 19. While a student was using power equipment, the equipment caught fire. The student lost time in locating a fire extinguisher and then did not know how to operate the extinguisher, and as a result, she was not able to save the valuable equipment from the fire. What safety rule(s) was **not** followed in this situation?

a. Know how to use fire extinguishers.
b. Be familiar with the location of fire-fighting and first-aid equipment.
c. Both a and b
d. Neither a nor b

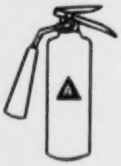
Assignment Sheet 2

_______ 20. Which of the following is the golden rule that applies to each tool, machine, or piece of equipment you may operate in the laboratory?

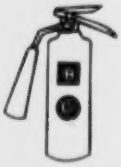
a. Operate equipment only after receiving training on how to use it properly and safely.
b. Operate equipment only when you are accompanied by a classmate.
c. Operate equipment only after your lab partner has demonstrated how he or she uses it.
d. Operate equipment at your own risk.

_______ 21. Choose the correct fire extinguisher for a fire in a waste basket full of paper ignited by a cigarette.

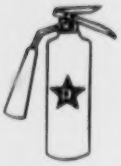
a.



b.



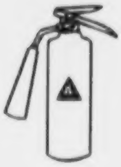
c.



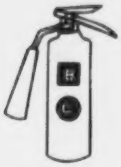
Assignment Sheet 2

_______ 22. Choose the correct fire extinguisher for a fire caused when a 5-gallon can of gasoline spills and ignites from the flame of a propane space heater.

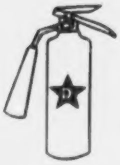
a.



b.



c.



_______ 23. Which of the following are proper color-coding uses for federal safety black and white?

a. Indicating traffic-flow paths
b. Indicating storage areas
c. Neither a nor b
d. Both a and b

_______ 24. Which of the following is a safety rule you should **not** follow for preventing electrical shock when working with electrical equipment in the laboratory?

a. Immediately report to your instructor all defective equipment and worn or frayed electrical cords.
b. Be extremely careful when you run electrical equipment while you are cleaning it.
c. Avoid using extension cords and overloading outlets.
d. Know the location of the main power switch in case electrical power must be turned off in an emergency.

_______ 25. Which of the following statements are things you should do when a spill occurs in the laboratory?

a. Wipe up the spill immediately.
b. Post a warning sign that informs others that the floor is wet.
c. Both a and b
d. Neither a nor b

Assignment Sheet 2

Part B **Identify safety violations in a laboratory scenario**

Directions Study the following laboratory scenario. In this scenario, a student commits several safety violations while working in the laboratory. Find six of these safety violations in the scenario and list them on the blanks provided on the next page.

Scenario

While the instructor was out of the laboratory, a student wanted to make up work he had missed the day before. He thought that, since he had passed all the safety tests on all the machines in the lab, there was no reason why he couldn't take this time to do his make-up work in the lab. So, the student rolled up the sleeves of his long-sleeved shirt, put his watch in his pocket, and got to work. The work procedure the student had to perform was to drill two different-sized holes in a piece of lumber and then make a crosscut to trim the lumber to the proper length.

The only drill the student could find had a frayed cord, but the student thought it was all right to use the drill anyway because only a little bare wire was exposed on the cord.

Before plugging the drill in, the student made sure that the drill's locking switch was locked on and that the tool was properly grounded. The student did notice there was some water under his feet, but he planned to make sure he kept the drill's cord looped over his wrist to prevent the cord from getting wet or from getting in the way of the operation he would be performing. He put on his safety glasses and began to drill the first of the two holes in the lumber.

After drilling the first hole, the student made sure that the drill's locking switch was off, but he decided not to unplug the drill because he did not want to cause further damage to the frayed cord. The student then carefully followed the manufacturer's written procedures for changing the drill bit so that he could drill the second larger hole in the lumber.

His safety glasses kept sliding down his nose while he performed the first drilling procedure, so he took them off. He reasoned that he was not in any real danger if he took the glasses off while he was just drilling. He then began drilling the second hole in the lumber.

After completing the drilling procedures, the student put the drill on the floor to keep the work-bench area from getting cluttered. Then, he got out a circular saw so he could crosscut the lumber. Knowing the possible dangers of particles of wood getting into his eyes while sawing, the student put his safety glasses back on. He then made sure the locking switch on the saw was off and plugged the saw in. He placed the saw's power cord over his shoulder to keep it out of the path of the saw blade, and he started the cut. He noticed that the board seemed a little difficult to cut, and he was puzzled because the saw blade was out as far as it could go and the lumber was only one-inch stock. When he started smelling a burning odor, the student immediatley turned the saw off.

Assignment Sheet 2

The student then took the defective saw back to the proper place in the storage area, got out another saw, and finished the cut. After the student finished the cut, he released the saw's locking switch and noticed that the guard had retracted properly. He then returned both the drill and the second saw to the storage area and cleaned up his mess—like a good student should do.

Violation list

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

5. ______________________________

6. ______________________________

Basic Laboratory Safety
Unit 2

Assignment Sheet 3—Identify Safety Practices Followed in Your Technology Education Laboratory

Name ______________________ Date ____________

Evaluation criteria **Rating**

Directions have been followed. ______

Student responses are relevant and well thought out. ______

Overall rating ______

Evaluator's comments ______________________

Introduction Every technology education instructor has done a great deal of planning to organize his or her laboratory and to establish laboratory rules that will ensure your safety when you work in the laboratory. If you fully understand the safety planning your instructor has done, you will be more likely to see the importance and relevance of following the safety rules your instructor has established for your laboratory.

Exercise

Part A **Diagram the safety-related items in your laboratory**

Directions Your instructor will provide you with the written safety policies he or she expects you to follow when working in the lab. And, he or she will also take you on a tour of the laboratory. After you have read the written safety policies for your lab and taken the lab tour, draw a diagram of your laboratory showing the locations of the items listed below.

Draw a diagram of your laboratory that notes the location of the following items:

- Applications for the colors used in the federal safety color code
- Fire extinguisher(s)
- Fire-notification alarm
- Emergency exits
- Safety shut-off switch (electrical)
- Telephone and posted emergency telephone numbers
- First-aid kit

Assignment Sheet 3

Part B **Write an essay that answers safety-related questions**

Directions Study the written safety policies your instructor has established for your laboratory, and then, on a separate sheet(s) of paper, write an essay that answers the safety-related questions listed below.

Questions about the safety policies established for your technology education laboratory

1. What general laboratory safety rules (see Objective 3 in the information sheet) are a part of the written safety policy your instructor has provided to you?
2. What guidelines for maintaining a safe work area (see Objective 4) are a part of the written safety policy your instructor has provided to you?
3. What guidelines for dressing in the laboratory (see Objective 5) are a part of the written safety policy your instructor has provided to you?
4. What guidelines for preventing slips, trips, and falls (see Objective 6) are a part of the written safety policy your instructor has provided to you?
5. What guidelines for preventing electrical shock (see Objective 7) are a part of the written safety policy your instructor has provided to you?
6. What guidelines for preventing fire and fire spread (see Objective 8) are a part of the written safety policy your instructor has provided to you?
7. What guidelines for using flammable materials and toxic substances (see Objective 9) are a part of the written safety policy your instructor has provided to you?
8. What guidelines for using lab tools and power equipment (Objective 10) are a part of the written safety policy your instructor has provided to you?
9. What equipment and machines in your lab must you pass separate safety tests on before you are allowed to operate them?
10. What personal-protection devices or clothing are you required to wear when you are in the laboratory?
11. What type of fire extinguisher(s) is available in your laboratory? On what kinds of fires may it (they) be used?
12. What specific procedures are you required to follow for handling emergency situations in your laboratory (see Objective 11)?

Measuring and Related Math
Unit 3

Objective Sheet

Unit objective

After completing this unit, the student should be able to read U.S. customary and metric rules and to solve basic math problems required in technology education classes. The student should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the written test.

Specific objectives

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with math and measuring.
2. Label the place values of a whole number.
3. Distinguish among types of fractions.
4. Label the place values of a decimal number.
5. Name the values of prefixes associated with metric measurement.
6. Add whole numbers. (Assignment Sheet 1)
7. Subtract whole numbers. (Assignment Sheet 2)
8. Multiply whole numbers. (Assignment Sheet 3)
9. Divide whole numbers. (Assignment Sheet 4)
10. Reduce fractions to lowest terms. (Assignment Sheet 5)
11. Convert mixed numbers to improper fractions and improper fractions to mixed numbers. (Assignment Sheet 6)
12. Add fractions (Assignment Sheet 7)
13. Subtract fractions. (Assignment Sheet 8)
14. Add decimal numbers. (Assignment Sheet 9)
15. Subtract decimal numbers. (Assignment Sheet 10)
16. Multiply decimal numbers. (Assignment Sheet 11)
17. Divide decimal numbers. (Assignment Sheet 12)
18. Convert fractions to decimals. (Assignment Sheet 13)

Objective Sheet

19. Read U.S. customary and metric rules. (Assignment Sheet 14)

20. Compute U.S. customary/metric equivalents. (Assignment Sheet 15)

Measuring and Related Math
Unit 3

Information Sheet

1. **Terms and definitions associated with math and measuring**

- **Addition**—Process of totaling two or more numbers to find another number called a *sum*

  Example: 3 + 5 + 9 = 17

- **Decimal**—Fraction with an unwritten denominator of 10 or some power of 10; indicated with a point before the number

  Examples: 0.1 = 1/10, 0.06 = 6/100, 0.003 = 3/1000

- **Digit**—Any one of the ten symbols, 0 to 9, by which all numbers can be expressed

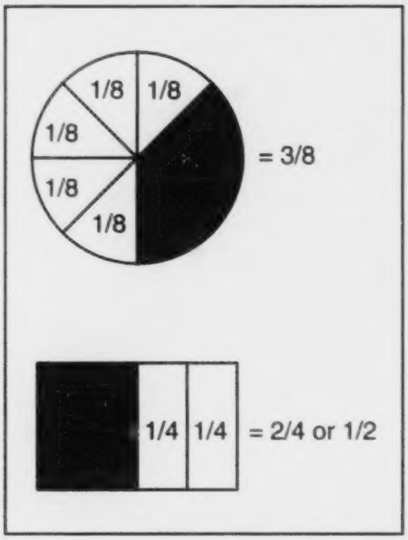
- **Division**—Opposite operation of multiplication

  Example: 16 ÷ 2 = 8 as opposed to 8 x 2 = 16

- **Fraction**—Part of a whole; represents one or more equal parts of a unit (see Figure 1)

  Examples: 3/8, 1/2, 1/4, 3/16

  Figure 1



- **Gram**—Metric unit used to measure mass or weight

- **Liter**—Metric unit used to measure capacity

- **Meter**—Metric unit used to measure length

BEST COPY AVAILABLE

Information Sheet

- **Multiplication**—Abbreviated process of adding a number to itself a specified number of times

  Example: 6 x 3 = 18 as opposed to 6 + 6 + 6 = 18

- **Percent**—One part in a hundred; reckoned on the basis of a whole divided into one hundred parts

- **Subtraction**—Opposite operation of addition

  Example: 8 – 4 = 4 as opposed to 4 + 4 = 8

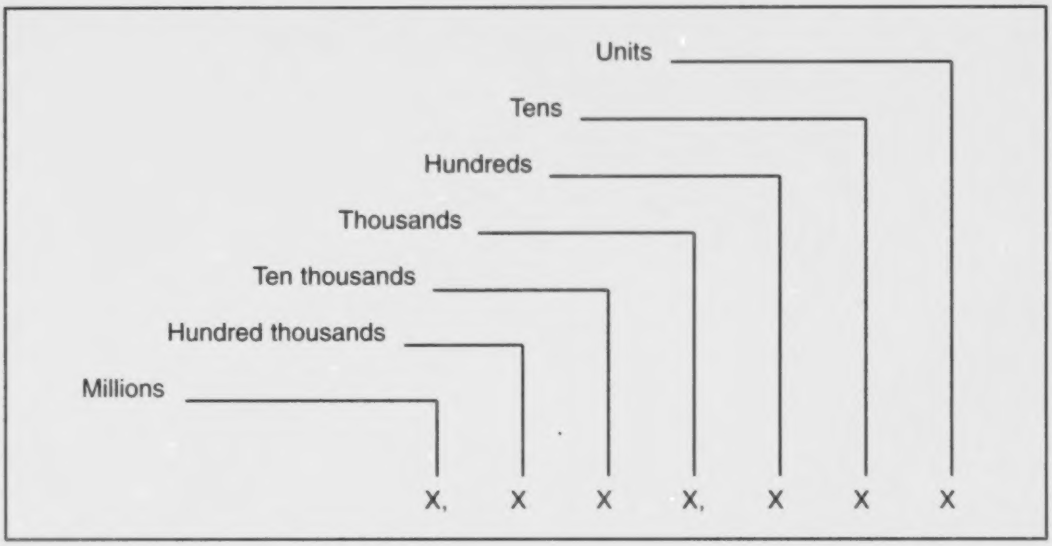
- **Whole number** (integer)—Any of the natural numbers, both positive and negative, that represent a complete item

  Example: 25 is a whole number as opposed to ¾, a fraction or part of a whole

2. **Place values of a whole number** (Figure 2)

Note: The position of a digit in a number shows how much that digit is worth. These positions—as shown in Figures 2 and 3 below—are called *place values.*

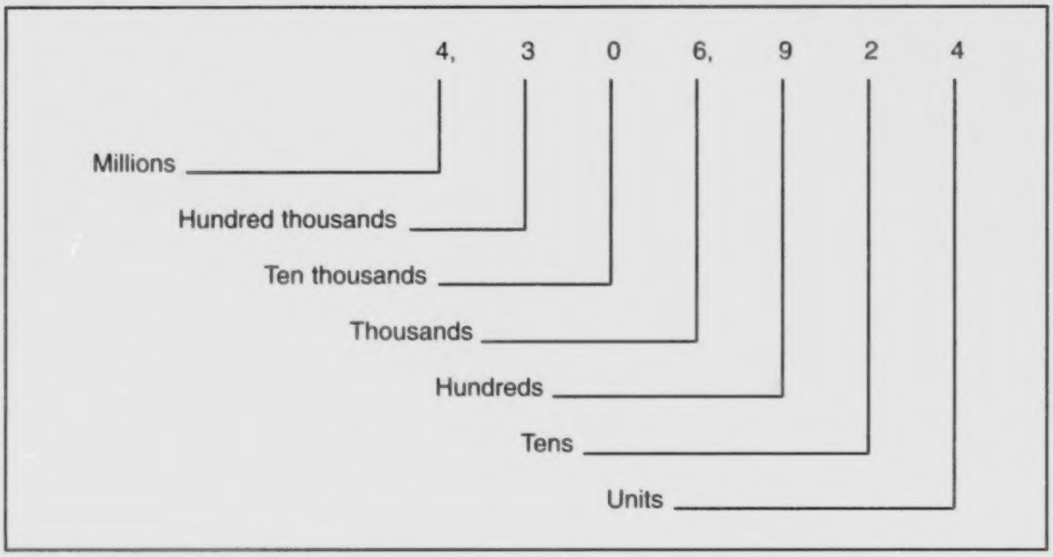
Figure 2


Units
Tens
Hundreds
Thousands
Ten thousands
Hundred thousands
Millions
X, X X X, X X X

Information Sheet

Example: The example number in Figure 3 below is read *four million, three hundred six thousand, nine hundred, twenty-four.*

Figure 3



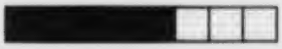
3. **Types of fractions and their descriptions**

- **Proper fractions**—Top number of the fraction (numerator) is smaller than the bottom number (denominator) (See Figure 4.)

  Example: ⅝

  Figure 4

  This figure is divided into eight equal parts:

  Five of the eight parts are shaded. 5/8 of the figure is shaded. We call 5/8 a fraction. A fraction has a numerator and a denominator.

  $\frac{5}{8}$ — Numerator / — Denominator

- **Improper fraction**—Top number of the fraction (numerator) is equal to or larger than the bottom number (denominator)

  Examples: 9/8, 16/16

- **Mixed number**—Fraction contains a whole number and a proper fraction

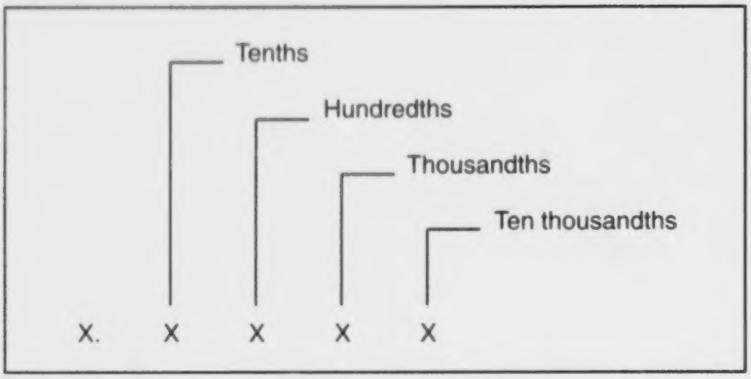
  Examples: 9 ½, 1 ⅞, 4 ¼

Information Sheet

4. **Place values of a decimal number** (See Figure 5.)

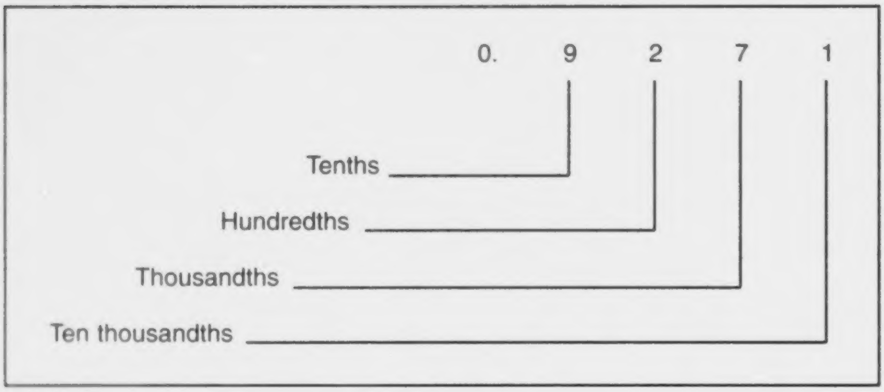
Note: As with whole numbers, the place values of a decimal number show how much each digit is worth. Those digits to the right of the decimal have decimal place values, while those digits to the left of the decimal will have whole-number place values (see Figure 6).

Figure 5


Tenths
Hundredths
Thousandths
Ten thousandths
X. X X X X

Example: The example number in Figure 6 below is read as *nine thousand two hundred and seventy-one ten thousandths.*

Figure 6


0. 9 2 7 1
Tenths
Hundredths
Thousandths
Ten thousandths

Information Sheet

5. **Values of prefixes associated with metric measurement** (Table 1)

Note: The basic units of measurement in the metric system are the meter (length), liter (capacity), and gram (mass or weight). Other units are named by adding the following prefixes to *meter*, *liter*, or *gram*. Since all measurement units in the metric system are powers of 10, metric prefixes make measurements easily understood. A millimeter, for instance, is one thousandth of a meter.

Table 1: Prefixes associated with metric measurement

Prefix	Value
kilo (k)	one thousand (1000)
hecto (h)	one hundred (100)
deka (da)	ten (10)
deci (d)	one tenth ($^1/_{10}$)
centi (c)	one hundredth ($^1/_{100}$)
milli (m)	one thousandth ($^1/_{1000}$)

Measuring and Related Math
Unit 3

Assignment Sheet 1—Add Whole Numbers

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	_______
85% of the questions have been answered correctly.	_______
Overall rating	_______

Evaluator's comments ____

____

____

Introduction

Like most people, you probably use addition every day. For example, today you probably added coins together to pay for a soft drink and snacks. Every time you add, you use basic addition facts. The following exercise will form part of your math background and serve as a basis for completing other exercises and problems in this unit.

Adding whole numbers

1. Set up the problem by writing units under units, tens under tens, and so on.

   Example: Add the whole numbers 1632, 17, and 550.

   $$\begin{array}{r} 1632 \\ 17 \\ \underline{+550} \end{array}$$

2. Add each column separately, beginning at the top of the units column.

   Example:

   $$\begin{array}{r} 1632 \\ 17 \\ \underline{+550} \\ 9 \end{array} \qquad \begin{array}{r} 1632 \\ 17 \\ \underline{+550} \\ 99 \end{array}$$

Assignment Sheet 1

3. If the sum of any column is two or more digits, write the units digit in your answer and carry the remaining digit(s) to the top of the next column to the left.

Example:

$$\begin{array}{lrrl} & & \mathbf{1} & \text{— Carry} \\ & 1632 & 1632 & \text{remaining} \\ & 17 & 17 & \text{digit.} \\ \text{Write} & \underline{+550} & \underline{+550} & \\ \text{units digit. —} & 199 & 199 & \end{array}$$

4. Add any carried digit(s) above the column with that column.

Example:

$$\begin{array}{rl} 1 & \text{— Carried digit} \\ 1632 & \\ 17 & \\ \underline{+550} & \\ 2199 & \end{array}$$

Exercise

Directions Solve each of the following addition problems. Show your work.

1. $\begin{array}{r} 2 \\ \underline{+\ 9} \end{array}$

2. $\begin{array}{r} 8 \\ \underline{+\ 8} \end{array}$

3. $\begin{array}{r} 7 \\ \underline{+\ 6} \end{array}$

4. $\begin{array}{r} 15 \\ \underline{+\ \ 8} \end{array}$

5. $\begin{array}{r} 81 \\ \underline{+\ 27} \end{array}$

6. $\begin{array}{r} 7 \\ 38 \\ \underline{+\ 43} \end{array}$

7. $\begin{array}{r} 55 \\ 88 \\ \underline{+\ 99} \end{array}$

8. $\begin{array}{r} 341 \\ 428 \\ \underline{+\ 769} \end{array}$

9. $\begin{array}{r} 472 \\ 564 \\ \underline{+\ 881} \end{array}$

10. $\begin{array}{r} 9876 \\ 5432 \\ \underline{+\ 1122} \end{array}$

Measuring and Related Math
Unit 3

Assignment Sheet 2—Subtract Whole Numbers

Name ______________________ Date ______________

Evaluation criteria **Rating**

Directions have been followed. ______

85% of the questions have been answered correctly. ______

Overall rating ______

Evaluator's comments ______________________________

Introduction

Addition is the first basic operation of mathematics. Subtraction, the opposite of addition, is the process of finding the difference between two numbers. It is the second basic math operation.

Subtracting whole numbers

1. Set up the problem by writing units under units, tens under tens, and so on.

   Note: The top number in the problem (original number) is almost always larger than the bottom number (subtracted number).

   Example: Subtract 91 from 123.

$$\begin{array}{rl} 1\,2\,3 & \text{Original number} \\ \underline{-\ \ 9\,1} & \text{Subtracted number} \end{array}$$

2. Subtract each column separately, beginning at the units column.

   Example:

$$\begin{array}{rl} 1\,2\,3 & \\ \underline{-\ \ 9\,1} & \uparrow \\ 2 & \end{array}$$

3. If a digit in the subtracted number is larger than the digit above it, "borrow" 1 from the top digit in the next column to the left, decreasing that digit by one and increasing the digit being subtracted from by ten.

   Example:

$$\begin{array}{r} 0 \\ \cancel{1}\,2\,3 \\ \underline{-\ \ 9\,1} \\ 2 \end{array} \qquad \begin{array}{r} 0\;12 \\ \cancel{1}\,\cancel{2}\,3 \\ \underline{-\ \ 9\,1} \\ 32 \end{array}$$

Assignment Sheet 2

4. If there is nothing to borrow in the next-left column (column contains a zero), first borrow for that column from its next-left column.

   Example:

$$\begin{array}{r} 9\,0\,6 \\ \underline{-3\,1\,8} \end{array} \qquad \begin{array}{r} \scriptstyle 8\;10\; \\ \cancel{9}\,\cancel{0}\,6 \\ \underline{-3\,1\,8} \end{array} \qquad \begin{array}{r} \scriptstyle 9\;\; \\ \scriptstyle 8\;\cancel{10}\; \\ \cancel{9}\,\cancel{0}\,6 \\ \underline{-3\,1\,8} \end{array} \qquad \begin{array}{r} \scriptstyle 9\;\;\;\; \\ \scriptstyle 8\;\cancel{10}\;16 \\ \cancel{9}\,\cancel{0}\,\cancel{6} \\ \underline{-3\,1\,8} \\ 5\,8\,8 \end{array}$$

5. Check your subtraction by adding your answer (difference) to the subtracted number.

   Example:

Problem		**Check**	
271	Original number	271 ←	Original number
− 164	Subtracted number	− 164	Subtracted number
107	Answer (difference)	+ 107	Answer (difference)
		271 ←	Check answer

   Note: If you solve the problem correctly, your check answer should be the same as the original number.

Exercise

Directions Solve each of the following subtraction problems. Check your answers by adding the difference to the subtracted number.

1. $\begin{array}{r} 9 \\ \underline{-5} \end{array}$

2. $\begin{array}{r} 15 \\ \underline{-\;8} \end{array}$

3. $\begin{array}{r} 75 \\ \underline{-22} \end{array}$

4. $\begin{array}{r} 453 \\ \underline{-\;\;47} \end{array}$

5. $\begin{array}{r} 742 \\ \underline{-318} \end{array}$

6. $\begin{array}{r} 981 \\ \underline{-698} \end{array}$

7. $\begin{array}{r} 1420 \\ \underline{-\;\;245} \end{array}$

8. $\begin{array}{r} 3459 \\ \underline{-1649} \end{array}$

9. $\begin{array}{r} 55{,}722 \\ \underline{-\;\;4{,}272} \end{array}$

10. $\begin{array}{r} 98{,}679 \\ \underline{-\;\;8{,}957} \end{array}$

Measuring and Related Math
Unit 3

Assignment Sheet 3—Multiply Whole Numbers

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	______
85% of the questions have been answered correctly.	______
Overall rating	______

Evaluator's comments ______________________________

Introduction

Multiplication is the third basic operation in mathematics. It is a shortcut method of adding. For example, if you correctly add twelve 12s, the result will be 144, the same as 12 multiplied by 12. Some multiplication problems involve carrying. You may write down the carried digits, or simply remember them. Use the method that works best for you. Follow the steps below for multiplying whole numbers.

Multiplying whole numbers

1. Set up the problem by writing the larger number (original number) above the smaller number (multiplier), writing units under units, tens under tens, and so on.

   Note: You will get the correct answer (product) no matter which number is placed above the other, but the faster method places the larger above the smaller.

   Example: Multiply the numbers 53 and 4.

   $$\begin{array}{rl} 53 & \text{Original number} \\ \underline{\times\ 4} & \text{Multiplier} \end{array}$$

2. If the multiplier contains only one digit, multiply each digit in the original number by it, working from right to left.

   a. Multiply the units digit in the original number by the multiplier.

Assignment Sheet 3

b. Write the answer units digit, and insert the necessary carry digit above the next-left column in the original number as required.

Example:
$$\begin{array}{r} 1 \\ 53 \\ \underline{\times\ 4} \\ 2 \end{array} \quad \text{— Carried digit}$$

c. Multiply the tens digit by the multiplier and add the carried digit as required.

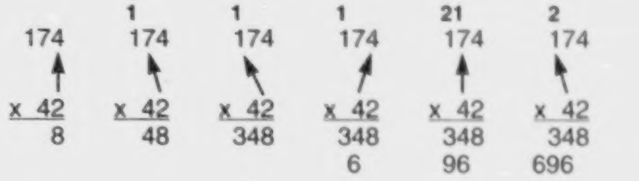
Example:
$$\begin{array}{r} 1 \\ 53 \\ \underline{\times\ 4} \\ 212 \end{array}$$

3. If the multiplier contains more than one digit, find the partial products.

   a. Multiply each digit in the original number by each digit in the multiplier. Moving from right to left.

   b. Align the partial products so that the right-hand digit of each is directly under its corresponding digit in the multiplier.

   Example: Multiply the numbers 174 and 42.



First partial product

Second partial product

   c. Add the partial products.

   Example:
$$\begin{array}{r} 174 \\ \underline{\times\ 42} \\ 348 \\ \underline{696\ \ } \\ 7308 \end{array} \quad \text{— Answer (product)}$$

Note: If multiplication is difficult for you, study the suggestions in Student Supplement 1 on page 81.

Assignment Sheet 3

Exercise

Directions Solve the following multiplication problems.

1. $\begin{array}{r} 6 \\ \underline{\text{x } 7} \end{array}$

2. $\begin{array}{r} 9 \\ \underline{\text{x } 8} \end{array}$

3. $\begin{array}{r} 54 \\ \underline{\text{x } 6} \end{array}$

4. $\begin{array}{r} 721 \\ \underline{\text{x } \quad 4} \end{array}$

5. $\begin{array}{r} 1682 \\ \underline{\text{x } \quad 5} \end{array}$

6. $\begin{array}{r} 78 \\ \underline{\text{x } 26} \end{array}$

7. $\begin{array}{r} 453 \\ \underline{\text{x } 47} \end{array}$

8. $\begin{array}{r} 314 \\ \underline{\text{x } 527} \end{array}$

9. $\begin{array}{r} 2143 \\ \underline{\text{x } 235} \end{array}$

10. $\begin{array}{r} 4123 \\ \underline{\text{x } 1324} \end{array}$

Measuring and Related Math
Unit 3

Student Supplement 1—Multiplication Table

Introduction

This supplement is designed to help you master multiplying any two numbers from zero to twelve in your head without using pencil and paper. It is not practical to add, for instance, seven 9s in a column when you can memorize the multiplication table and perform calculations more quickly in your head.

To use the table below, locate the row and column numbers that you want to multiply, and then, move down and over to the number where the row and column numbers meet. This number will be the answer (product) of multiplying the two numbers. Memorize *all* of the products of any two numbers multiplied together.

Example: 2 x 5 = 10

Column	Row											
	1	2	3	4	5	6	7	8	9	10	11	12
	2	4	6	8	10	12	14	16	18	20	22	24

Multiplication Table

Column	Row											
	1	2	3	4	5	6	7	8	9	10	11	12
	2	4	6	8	10	12	14	16	18	20	22	24
	3	6	9	12	15	18	21	24	27	30	33	36
	4	8	12	16	20	24	28	32	36	40	44	48
	5	10	15	20	25	30	35	40	45	50	55	60
	6	12	18	24	30	36	42	48	54	60	66	72
	7	14	21	28	35	42	49	56	63	70	77	84
	8	16	24	32	40	48	56	64	72	80	88	96
	9	18	27	36	45	54	63	72	81	90	99	108
	10	20	30	40	50	60	70	80	90	100	110	120
	11	22	33	44	55	66	77	88	99	110	121	132
	12	24	36	48	60	72	84	96	108	120	132	144

Measuring and Related Math
Unit 3

Assignment Sheet 4—Divide Whole Numbers

Name ______________________________ Date ______________

Evaluation criteria **Rating**

Directions have been followed. ______

85% of the questions have been answered correctly. ______

Overall rating ______

Evaluator's comments ______________________________

____

____

Introduction

Division is the fourth and last basic operation in mathematics. Multiplication puts together; division takes apart. Division is the reverse of multiplication. Division answers are checked by multiplying the divisor by the answer and adding the remainder. Follow the steps below for dividing whole numbers.

Dividing whole numbers

1. Set up the problem by writing the original number (number to be divided) inside a division frame, and by writing the divisor (number you are dividing by) outside the frame.

   Example: How many times will 34 go into 3347?

   Divisor $34\overline{)3347}$ Original number

2. Determine how many times the divisor will go into the first digit of the original number; if it will not, write a zero in the answer space directly above the first digit, then determine how many times the divisor will go into the first two numbers of the original number.

   Note: Continue trying to divide the original number by the divisor until a set of digits can be divided. Remember to write a zero each time the set of digits cannot be divided.

   Example: $\begin{array}{r} 0 \\ 34\overline{)3347} \end{array}$ 34 goes into 3 zero times.

   $\begin{array}{r} 00 \\ 34\overline{)3347} \end{array}$ 34 goes into 33 zero times.

   $\begin{array}{r} 009 \\ 34\overline{)3347} \end{array}$ 34 goes into 334 nine times.

Assignment Sheet 4

3. Multiply the divisor by the answer (digit above frame); write this answer under the digits that the divisor went into and subtract.

Example:

$$\begin{array}{r} 34\\ \underline{\times\ 9}\\ 306 \end{array}$$

Multiply divisor (34) by answer (9).

$$\begin{array}{r} 009\\ 34\overline{)3347}\\ -\underline{306}\\ 28 \end{array}$$

Write answer under 334, the digits divisor went into, and subtract.

4. Bring down the next unused digit from the original number, and place it to the right of the subtracted difference (remainder)—even if the remainder is zero.

Example:

$$\begin{array}{r} 009\\ 34\overline{)3347}\\ \underline{306}\downarrow\\ 287 \end{array}$$

5. Determine how many times the divisor will go into this new number; write your answer directly above the digit that was brought down.

Example:

$$\begin{array}{r} 0098\\ 34\overline{)3347}\\ \underline{306}\\ 287 \end{array}$$

6. Multiply the divisor by the last digit you wrote in the answer; write this product under the digits that the divisor went into, and subtract.

Example:

$$\begin{array}{r} 34\\ \underline{\times\ 8}\\ 272 \end{array}$$

Multiply divisor (34) by last digit of answer (8).

$$\begin{array}{r} 0098\\ 34\overline{)3347}\\ \underline{306}\\ 287\\ -\underline{272}\\ 15 \end{array}$$

Write product under 287, the digits that divisor went into, and subtract.

7. Continue this process until all the numbers in the original number are used; write any remaining subtracted difference as a remainder.

Example:

$$\begin{array}{r} 0098\\ 34\overline{)3347}\\ \underline{306}\\ 287\\ -\underline{272}\\ 15 \end{array}$$

Remainder

Assignment Sheet 4

8. Check your answer by multiplying your answer times the divisor and adding the remainder to this number; your check answer should be the same as the original number.

Example:	98	Answer
	x 34	Divisor
	392	
	294	
	3332	
	+ 15	Remainder
	3347	Check answer (same as original number)

Exercise

Directions Solve the following division problems. Check your answers by multiplying the divisor by the original number.

1. $2\overline{)8}$
2. $6\overline{)48}$
3. $9\overline{)819}$
4. $4\overline{)1248}$
5. $13\overline{)39}$
6. $66\overline{)198}$
7. $84\overline{)5208}$
8. $124\overline{)2604}$
9. $464\overline{)928}$
10. $746\overline{)2238}$

Measuring and Related Math
Unit 3

Assignment Sheet 5—Reduce Fractions to Lowest Terms

Name ______________________ Date ______________

Evaluation criteria **Rating**

Directions have been followed. ______

85% of the questions have been answered correctly. ______

Overall rating ______

Evaluator's comments ______________________

Introduction

Fractions are "reduced" to their lowest terms so that they are more readily understood or recognized. For example, ½ is more easily recognized than $^{16}/_{32}$.

Reducing proper fractions

To reduce proper fractions to their lowest terms, divide the numerator (top number) and the denominator (bottom number) by the largest whole number that will go into each evenly.

Example: Reduce $^{4}/_{16}$ to its lowest terms.

$$^{4}/_{16} = \frac{4 \div 4}{16 \div 4} = {}^{1}/_{4}$$

Note: The fraction $^{1}/_{4}$ is reduced to its lowest terms because the numerator (1) and the denominator (4) cannot be divided evenly by the same number.

Reducing improper fractions

1. Divide the numerator by the denominator.

   Example: Reduce $^{20}/_{16}$ to its lowest terms.

   $20 \div 16 = 1\ ^{4}/_{16}$

2. Reduce the resulting fraction to its lowest terms as for proper fractions.

   Example: $4/16 = \frac{4 \div 4}{16 \div 4} = 1/4$

3. Add the reduced fraction to its whole number.

   Example: $1 + 1/4 = 1\,1/4$ Answer

Exercise

Directions Reduce the following fractions to their lowest terms. Show your work in the space below the problems, and then, write your answers on the blanks below.

1. $4/8$ = ________
2. $8/16$ = ________
3. $2/2$ = ________
4. $4/16$ = ________
5. $12/36$ = ________
6. $9/24$ = ________
7. $16/32$ = ________
8. $12/9$ = ________
9. $5/2$ = ________
10. $36/8$ = ________

Measuring and Related Math
Unit 3

Assignment Sheet 6—Convert Mixed Numbers to Improper Fractions and Improper Fractions to Mixed Numbers

Name ______________________ Date ______________

Evaluation criteria **Rating**

Directions have been followed. ________

85% of the questions have been answered correctly. ________

Overall rating ________

Evaluator's comments ______________________

Introduction

A fraction such as $\frac{3}{4}$ is called a *proper fraction* because its numerator (top number) is smaller than its denominator (bottom number). Some examples of proper fractions are $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{7}{8}$.

When the numerator of a fraction is the same or larger than the denominator, the fraction is called an *improper fraction*. Some examples of improper fractions are $\frac{4}{4}$, $\frac{5}{3}$, $\frac{9}{4}$, and $\frac{10}{8}$.

Numbers such as 2 $\frac{1}{2}$, 5 $\frac{3}{4}$, and 6 $\frac{2}{5}$ are called *mixed numbers*. They are made up of a whole number and a proper fraction.

Follow the steps below for converting mixed numbers to improper fractions and improper fractions to mixed numbers.

Converting mixed numbers to improper fractions

1. Multiply the whole number by the denominator of the fraction.

   Example: Convert 4 $\frac{3}{8}$ to an improper fraction.

   $8 \times 4 = 32$

2. Add your answer to the numerator.

   Example: $32 + 3 = 35$

3. Place this sum over the original denominator.

   Example: $\frac{35}{8}$ Improper fraction

Assignment Sheet 6

Converting improper fractions to mixed numbers

1. Divide the numerator by the denominator.

   Example: Convert 18/15 to a mixed number.

$$\begin{array}{r} 01 \\ 15\overline{)18} \\ -\underline{15} \\ 3 \text{ Remainder} \end{array}$$

2. Place the remainder over the denominator.

   Example: $\underline{3}$ — Remainder
   15 — Denominator

3. Reduce this fraction if necessary.

   Example: $3/15 = \frac{3 \div 3}{15 \div 3} = 1/5$

4. Add the reduced fraction to the whole number obtained by dividing the numerator by the denominator.

   Example: 1 + 1/5 = 1 1/5 Mixed number

Exercise

Directions This assignment sheet is divided into three parts. Read each part, and then, answer the questions in each part.

Part A Distinguish among the following fractions by writing a "P" on the blank after a proper fraction, and an "I" after an improper fraction, and an "M" on the blank after a mixed number.

1. 1/2 = ________
2. 3 7/8 = ________
3. 16/2 = ________
4. 3 1/8 = ________
5. 1/4 = ________
6. 1/1 = ________
7. 7/2 = ________
8. 8 1/2 = ________
9. 4/4 = ________
10. 9 3/16 = ________
11. 5 1/2 = ________
12. 9/8 = ________
13. 9/4 = ________
14. 1/8 = ________
15. 16 3/4 = ________

Assignment Sheet 6

Part B Convert the following mixed numbers to improper fractions. Show your work in the space provided below the problems. Reduce to lowest terms when possible. Write your answers on the blanks beside the problems.

1. 3 ¼ = ________
2. 4 ½ = ________
3. 7 ¾ = ________
4. 8 ½ = ________
5. 6 ⅛ = ________
6. 5 2⁄4 = ________
7. 4 ¼ = ________
8. 9 ½ = ________
9. 9 ¼ = ________
10. 16 ½ = ________

Assignment Sheet 6

Part C Convert the following improper fractions to mixed numbers. Show your work in the space provided below the problems. Reduce to lowest terms when possible. Write your answers on the blanks beside the problems.

1. $^{7}/_{4}$ = ________
2. $^{9}/_{2}$ = ________
3. $^{6}/_{4}$ = ________
4. $^{15}/_{8}$ = ________
5. $^{19}/_{16}$ = ________
6. $^{11}/_{8}$ = ________
7. $^{75}/_{32}$ = ________
8. $^{5}/_{2}$ = ________
9. $^{15}/_{4}$ = ________
10. $^{33}/_{16}$ = ________

Measuring and Related Math
Unit 3

Assignment Sheet 7—Add Fractions

Name ______________________________ Date ______________

Evaluation criteria **Rating**

Directions have been followed. ______

85% of the questions have been answered correctly. ______

Overall rating ______

Evaluator's comments ______________________________

Introduction Technology education students are often required to take measurements. These procedures require the computation of missing or needed dimensions. Whole numbers alone are not sufficient to obtain specific dimensions. Therefore, the student must be able to add fractional parts. The steps for adding fractions are outlined below.

Adding like fractions

Example: Add $\frac{3}{4}$ and $\frac{3}{4}$.

1. Add the numerators.

   Example: $3 + 3 = 6$

2. Place the answer over the common denominator and reduce to lowest terms if necessary.

   Example: $\frac{6}{4} = 1\frac{2}{4} = 1\frac{1}{2}$ Answer

Adding unlike fractions

Example: Add $\frac{1}{4}$ and $\frac{7}{8}$.

1. Change to equivalent fractions with the lowest common denominator.

   Example: $\frac{7}{8}$ remains the same, as 8 is the lowest common denominator.

   $\frac{1}{4}$ is multiplied by $\frac{2}{2}$, or $\frac{1}{4} \times \frac{2}{2} = \frac{2}{8}$.

Assignment Sheet 7

2. Add the new numerators.

   Example: $\frac{7 + 2}{8} = \frac{9}{8}$

3. Change the improper fraction to a mixed number and reduce to lowest terms if necessary.

   Example: $\frac{9}{8} = 9 \div 8 = 1\,\frac{1}{8}$ Answer

Adding mixed numbers

Example: Add $3\,\frac{5}{8}$ and $7\,\frac{5}{8}$.

1. Add the numerators.

   Example: $\frac{5 + 5}{8} = \frac{10}{8}$

2. Change the improper fraction to a mixed number and reduce to lowest terms if necessary.

   Example: $\frac{10}{8} = 10 \div 8 = 1\,\frac{2}{8} = 1\,\frac{1}{4}$

3. Add whole numbers and fractions.

   Example: $3 + 7 + 1 + \frac{1}{4} = 11\,\frac{1}{4}$ Answer

Exercise

Directions This assignment sheet is divided into two parts. Read each part, and then, answer the questions in each part.

Part A Add the following fractions. Show your work in the space provided below the problems. Reduce to lowest terms if necessary. Write your answers on the blanks beside the problems.

1. $\frac{7}{16} + \frac{5}{16} =$ ________
2. $\frac{5}{8} + \frac{7}{8} =$ ________
3. $\frac{1}{4} + \frac{2}{8} =$ ________
4. $\frac{4}{16} + \frac{3}{4} =$ ________
5. $\frac{9}{16} + \frac{5}{8} =$ ________
6. $\frac{5}{8} + \frac{5}{32} =$ ________
7. $\frac{3}{4} + \frac{5}{32} =$ ________
8. $\frac{7}{8} + \frac{6}{16} =$ ________
9. $\frac{9}{16} + \frac{3}{4} =$ ________
10. $\frac{4}{4} + \frac{25}{32} =$ ________

Assignment Sheet 7

Part B Solve the following problems. Show your work in the spaces provided. Reduce to lowest terms if necessary. Write your answers on the blanks.

1. Add the lengths of two wires that are 6 ½ inches and 8 ¼ inches.

   Total length in inches = ________________

2. Add the lengths of three extension tools that are 2 ⅛ inches, 3 ¼ inches, and 1 13/16 inches.

   Total length in inches = ________________

3. Three pieces of hose have lengths of 6 ⅝ inches, 6 ¾ inches, and 6 ¼ inches. What is the total length of the three pieces of hose?

   Total length in inches = ________________

4. In learning to read a U.S. customary rule, Student A located 4 ⅞ inches on the rule, Student B read 3 15/16 inches, and Student C located 4 ¼ inches. How many total inches were located?

   Total inches = ________________

5. A container of oil has 2 ½ liters in it. A student adds 1 ¾ liters. How many liters are now in the container?

   Total liters of oil = ________________

Measuring and Related Math
Unit 3

Assignment Sheet 8—Subtract Fractions

Name ______________________ Date ____________

Evaluation criteria	**Rating**
Directions have been followed.	______
85% of the questions have been answered correctly.	______
Overall rating	______

Evaluator's comments ________________________________

____

____

Introduction

Just as the technology education student needs to know how to add fractions to compute day-to-day measurements and amounts, the student must also know how to subtract fractions.

Follow the steps outlined below for subtracting various types of fractions.

Subtracting like fractions

Example: Subtract $\frac{1}{16}$ from $\frac{7}{16}$.

1. Subtract the smaller numerator from the larger numerator.

   Example: $7 - 1 = 6$

2. Place the answer over the common denominator.

   Example: $\frac{6}{16}$

3. Reduce to lowest terms if required.

   Example: $\frac{6}{16} = \frac{3}{8}$ Answer

Assignment Sheet 8

Subtracting unlike fractions

Example: Subtract $\frac{1}{2}$ from $\frac{3}{4}$.

1. Change to like fractions.

   Example: $\frac{3}{4}$ remains the same because 4 is the common denominator.

   $\frac{1}{2}$ is multiplied by $\frac{2}{2}$, or $\frac{1}{2} \times \frac{2}{2} = \frac{2}{4}$.

2. Subtract as for like fractions and reduce to lowest terms if required.

   Example: $\frac{3}{4} - \frac{2}{4} = \frac{1}{4}$ Answer

Subtracting mixed numbers

Example: Subtract $3\frac{1}{2}$ from $5\frac{1}{8}$.

1. Change mixed numbers to like fractions.

   Example: $3\frac{1}{2} = 3\frac{4}{8}$

2. Borrow a 1 from the original whole number if needed, and convert the 1 to a like fraction, and add it to the smaller fraction.

   Note: This step is needed only if the like fraction in the original number is smaller than the like fraction in the subtracted number.

   Example: $5\frac{1}{8} - 3\frac{4}{8} = (4\frac{8}{8} + \frac{1}{8}) - 3\frac{4}{8} = 4\frac{9}{8} - 3\frac{4}{8}$

3. Subtract whole number from whole number and like fraction from like fraction, and reduce the answer to the lowest terms if required.

   Example: $4\frac{9}{8} - 3\frac{4}{8} = 1\frac{5}{8}$ Answer

Subtracting a fraction from a whole number

Example: $4 - \frac{3}{16}$

1. Borrow 1 from the whole number.

   Example: $4 - 1 = 3$

2. Change the borrowed 1 to a like fraction.

   Example: $1 = \frac{16}{16}$

3. Subtract as for like fractions and reduce the answer to lowest terms if required.

   Example: $3\frac{16}{16} - \frac{3}{16} = 3\frac{13}{16}$ Answer

Assignment Sheet 8

Exercise

Directions This assignment sheet is divided into five parts. Read each part, and then, answer the questions in each part.

Part A Subtract the proper fractions given below. Show your work in the spaces provided. Reduce to lowest terms if necessary. Write your answers on the blanks.

1. $\frac{3}{4} - \frac{3}{16} =$ ________
2. $\frac{7}{8} - \frac{1}{4} =$ ________
3. $\frac{30}{32} - \frac{3}{4} =$ ________
4. $\frac{25}{32} - \frac{5}{8} =$ ________
5. $\frac{7}{8} - \frac{2}{16} =$ ________
6. $\frac{15}{16} - \frac{3}{8} =$ ________
7. $\frac{1}{2} - \frac{7}{16} =$ ________
8. $\frac{3}{4} - \frac{3}{8} =$ ________
9. $\frac{13}{16} - \frac{9}{32} =$ ________
10. $\frac{7}{8} - \frac{6}{16} =$ ________

Assignment Sheet 8

Part B Subtract the following fractions from whole numbers. Show your work in the spaces provided. Reduce to lowest terms if necessary. Write your answers on the blanks.

1. $4 - \frac{3}{4} =$ ________
2. $7 - \frac{15}{16} =$ ________
3. $32 - \frac{13}{32} =$ ________
4. $175 - \frac{4}{5} =$ ________
5. $12 - \frac{61}{64} =$ ________

Part C Subtract the following mixed numbers from whole numbers. Show your work in the spaces provided. Reduce to lowest terms if necessary. Write your answers on the blanks.

1. $2 - 1\frac{1}{3} =$ ________
2. $3 - 1\frac{3}{8} =$ ________
3. $18 - 9\frac{7}{8} =$ ________
4. $3 - 1\frac{21}{32} =$ ________
5. $27 - 1\frac{5}{16} =$ ________
6. $14 - 6\frac{3}{4} =$ ________

Assignment Sheet 8

7. $5 - (3\frac{5}{32} + 1\frac{9}{32}) =$ ________

8. $8 - (1\frac{1}{4} + 5\frac{1}{16}) =$ ________

9. $4 - 3\frac{1}{3} =$ ________

10. $42 - 3\frac{7}{16} =$ ________

Part D Subtract the following mixed numbers. Show your work in the spaces provided. Reduce to lowest terms if necessary. Write your answers on the blanks.

1. $1\frac{3}{5} - 1\frac{1}{5} =$ ________

2. $72\frac{6}{16} - 22\frac{7}{16} =$ ________

3. $7\frac{5}{6} - 2\frac{1}{6} =$ ________

4. $18\frac{7}{8} - 9\frac{3}{8} =$ ________

5. $35\frac{5}{8} - 8\frac{1}{2} =$ ________

6. $5\frac{1}{4} - (1\frac{1}{8} + 1\frac{7}{8}) =$ ________

7. $12\frac{1}{2} - (7\frac{1}{4} + 3\frac{1}{8}) =$ ________

8. $4\frac{29}{32} - 1\frac{19}{32} =$ ________

9. $5\frac{15}{32} - 2\frac{31}{32} =$ ________

10. $8\frac{1}{16} - 4\frac{7}{8} =$ ________

Assignment Sheet 8

Part E Solve the following word problems. Show your work in the spaces provided. Reduce to lowest terms if necessary. Write your answers on the blanks.

1. A student had a ⅞-inch wrench but needed a ¾-inch wrench. How much difference is there in the size of the wrenches?

   Difference in inches = ________________

2. A motor base is to be set up 4 ½ inches from the floor. Two wooden blocks must be used. If one block is 1 ⅝ inches thick, how thick must the second block be?

   Thickness of block in inches = ________________

3. Three pieces of hose are cut from a piece 35 ½ inches long. The lengths are 7 ¼ inches, 11 ⅜ inches, and 6 ½ inches. If ⅜ inch of hose is wasted in cutting, how much hose is left?

   Length of hose left in inches = ________________

4. A piece of hose is 32 ½ inches long. Short pieces of the following lengths are cut from it: 6 ½ inches, 5 ¼ inches, 8 13/16 inches, and 10 9/16 inches. How much hose is left?

   Amount of hose left in inches = ________________

5. An engine needs 4 ¼ liters of oil. How much oil is left after the engine uses ½ liter?

   Number of liters = ________________

Measuring and Related Math
Unit 3

Assignment Sheet 9—Add Decimal Numbers

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	______
85% of the questions have been answered correctly.	______
Overall rating	______

Evaluator's comments ______________________________

Introduction

Metric measurements are calculated as decimal numbers, the numbers to the right of the decimal being parts of a whole. Because they are parts of a whole, decimal numbers are sometimes called *decimal fractions* as opposed to proper fractions in which there is a numerator and denominator. Decimal fractions differ from proper fractions also in that they indicate units of 10s.

The technology education student needs to be able to calculate metric measurements. Every time students total the sum of specific metric measurements, they are adding decimals.

Decimals are added just as whole numbers are added. You must be careful, though, to keep all decimal points aligned. Follow the steps below for adding decimal fractions.

Adding decimal numbers

1. Set up the problem as for addition of whole numbers, aligning decimal points directly under each other.

   Note: Zeros may be added to ensure that units line up under units, tens under tens, and so on. Whole numbers have an understood decimal point to the right of the units digit: 7 is 7., 75 is 75., and 754 is 754., for instance.

   Example: Add 0.857, 2.1, 753, and 370.057.

0.857		000.857
2.1		002.100
753.	or	753.000
+ 370.057		+ 370.057

Assignment Sheet 9

2. Add each column of digits as for whole numbers.
3. Locate the decimal point in the answer by placing it directly under the decimal points above.

Example:

```
 000.857
 002.100
 753.000
+370.057
1126.014   Answer
```

Exercise

Directions This assignment sheet is divided into three parts. Read each part, and then, answer the questions in each part.

Part A

1. Write the name of the place for each *underlined* digit.

______________________ a. 867.$\underline{4}$3

______________________ b. 6.3$\underline{7}$892

______________________ c. 1.0000$\underline{8}$

______________________ d. 6.239$\underline{5}$

______________________ e. 0.47$\underline{6}$

2. Write the name of the place for the last digit in each of the following numbers.

______________________ a. 0.38

______________________ b. 0.4678

______________________ c. 321.9

______________________ d. 427.389

______________________ e. 44.67

3. Underline the digit that is in the place named in italics.

a.	46.3826	*Hundredths*
b.	35.0038	*Ten thousandths*
c.	148.296	*Tenths*
d.	6758.23	*Hundredths*
e.	91.4082	*Thousandths*
f.	204.37	*Tens*

Assignment Sheet 9

g.	14.0079	*Ones (units)*
h.	208.097	*Hundredths*
i.	5.23981	*Thousandths*
j.	502.967	*Tenths*
k.	5230.867	*Thousandths*
l.	587.029	*Ones (units)*
m.	0.298	*Hundredths*
n.	329.768	*Tens*
o.	52.694	*Thousandths*
p.	498.276	*Tenths*
q.	0.5296	*Ten thousandths*
r.	468.539	*Hundreds*
s.	324.06	*Tenths*
t.	567.8	*Ones (units)*

Part B Set up the following groups of numbers in columns. Add each column, carrying when necessary and placing the decimal point correctly. Show your work in the spaces provided.

1. 0.024 + .165

2. 87.3 + 370

3. 15.127 + 3.4 + .0091 + 236.87

Assignment Sheet 9

4. 195.7 + 83 + 9.006

5. .5280 + 435 + 179.50 + 1.9

Part C Solve the following word problems. Show your work in the spaces provided. Write your answers on the blanks.

1. Student A used $22.50 of supplies to complete a class project, and Student B used $16.50. How much did they use together?

   Total amount used = ________________

2. To repair a piece of lab equipment, labor costs $54.65, parts cost $16.30, and the tax is $3.38. What is the total cost of the repair job?

   Total cost = ________________

3. A student worked four days on a certain project. The student worked 6.8 hours Monday, 7.4 hours Tuesday, 5.3 hours Wednesday, and 4.4 hours Thursday. How many total hours did the student work?

   Total hours worked = ________________

Assignment Sheet 9

4. A student was cleaning out a storage bin and found three partially used bottles of solvent, each containing the following amounts: 6.7 liters, 12.9 liters, and .5 liters. How many total liters of solvent were stored?

   Total liters of solvent = ________________

5. In one year, the technology education lab has the following expenses: parts, $429.33; electric bill, $160.16; telephone, $116.27; and new equipment and supplies, $15,312.50. What was the year's total expenditure?

   Total expense = ________________

Measuring and Related Math
Unit 3

Assignment Sheet 10—Subtract Decimal Numbers

Name ______________________________ Date ______________

Evaluation criteria **Rating**

Directions have been followed. ______

85% of the questions have been answered correctly. ______

Overall rating ______

Evaluator's comments ______________________________

Introduction Decimals are a part of our daily lives, in calculating time, distance, area, and many other quantities. In technology education and in other parts of our lives, decimals are becoming more common, especially with the increased use of metric measurements. Subtraction is one of the basic mathematical operations done with decimals. Follow the steps outlined below to subtract decimal numbers.

Subtracting decimal numbers

1. Set up the problem as for subtraction of whole numbers, aligning decimal points directly under each other.

   Example: Subtract 1.397 from 8.120.

8.120	Original number
− 1.397	Subtracted number

2. Subtract each column of numbers as for whole numbers.
3. Locate the decimal point in the answer by placing it directly under the decimal points above.
4. Check your subtraction by adding your answer to the subtracted number.

   Note: If you have solved the problem correctly, your check answer should be the same as the original number.

   Example:

8.120 ◄┐	Original number
− 1.397 │	Subtracted number
+ 6.723 │	Answer (difference)
8.120 ◄┘	Check answer

Assignment Sheet 10

Exercise

Directions This assignment sheet is divided into two parts. Read each part, and then, answer the questions in each part.

Part A Set up each of the following problems in column form. Subtract and check your work. Show your work in the spaces provided. Remember, when you subtract decimals, the decimal points must be aligned. Write your answers on the blanks.

1. 868.87 – 516.89 = ________________

2. 567 – 19.856 = ________________

3. 198 – 56.987 = ________________

4. 567.94 – 59.78 = ________________

5. \$815.23 – \$65.98 = ________________

6. \$20.03 – \$15.88 = ________________

Assignment Sheet 10

7. 694.7 − 24.3 = ________________

8. 5000 − 892.66 = ________________

9. $15 − $12.53 = ________________

10. $219.30 − $21.85 = ________________

Part B Solve the following word problems. Show your work in the spaces provided. Write your answers on the blanks.

1. The technology education laboratory received $8438.64 for expenses in September when school started, and had paid out $5121.32 by January. How much of the original funds were left in January?

   Amount of remaining funds = ________________

2. It takes 20.5 hours to finish a project. A student has worked 6 hours. How much longer will it take the student to finish the job?

   Hours required to finish job = ________________

Assignment Sheet 10

3. A length of hose 6.14 centimeters long was cut from a hose 8.98 centimeters in length. How much hose was left?

   Centimeters of hose left = ________________

4. A fuel tank holds 49.2 liters of gasoline. A student determines that 8.7 liters have been used. How much gasoline was left in the tank?

   Liters of gasoline in tank = ________________

5. A student misreads the instructor's directions and tightened bracket mounting nuts to 27.5 Newton-meters rather than the 55 Newton-meters specified. How many more Newton-meters must the bracket mounting nuts be tightened?

   Newton-meters = ________________

Measuring and Related Math
Unit 3

Assignment Sheet 11—Multiply Decimal Numbers

Name ____________________ Date ____________

Evaluation criteria	**Rating**
Directions have been followed.	______
85% of the questions have been answered correctly.	______
Overall rating	______

Evaluator's comments ____________________

____

____

Introduction Multiplication with decimals is similar to multiplication with whole numbers. However, with decimals you must take care in placing the decimal point correctly. The number of decimal places—those to the right of the decimal—in an answer must equal the total number of decimal places in the numbers that you multiplied. Follow the steps outlined below for multiplying decimal numbers.

Multiplying decimal numbers

1. Set up the problem and multiply as for multiplication of whole numbers.

   Note: Do **not** align the decimal points in columns when setting up multiplication problems for decimal numbers.

   Example: Multiply 27.935 by 7.07.

27.935	Original number
x 7.07	Multiplier
195545	
1955450	
19750045	

2. Add the number of decimal places to the right of the decimal points in the multiplier and the original number.

Example:			
	27.935	3	Decimal places
	x 7.07	+ 2	Decimal places
		5	Total decimal places

Assignment Sheet 11

3. Locate the decimal point in the answer by beginning at the far-right digit and counting off as many places to the left as the total decimal places found in Step 2.

Example:

$$\begin{array}{r} 27.935 \\ \underline{\times \quad 7.07} \\ 195545 \\ \underline{1955450\ } \\ 197.50045 \end{array} \quad = 5 \text{ Decimal places}$$

Exercise

Directions This assignment sheet is divided into two parts. Read each part, and then, answer the questions in each part.

Part A Set up the following problems in column form and multiply. Locate the decimal point in the answers. Show your work in the spaces provided. Write your answers on the blanks.

1. 2.64 x 3.1 = ____________________

2. 120 x 0.33 = ____________________

3. 2.25 x 0.51 = ____________________

4. 35 x 8.5 = ____________________

5. 26.4 x 3.8 = ____________________

Assignment Sheet 11

6. 7.02 x 0.92 = ________________

7. 0.83 x 0.55 = ________________

8. 28.2 x 0.9 = ________________

9. 0.069 x 0.01 = ________________

10. 7.52 x 3.01 = ________________

Part B Solve the following word problems. Show your work in the spaces provided. Write your answers on the blanks.

1. A tool kit is placed on sale for 25 percent off. By what amount is the price reduced if the regular price is $1349.80?

   Note: Twenty-five percent is the same as the decimal .25.

   Price reduction = ________________

Assignment Sheet 11

2. The average cost of a replacement part is $41.25. During the year, a technology education class uses 150 such parts. What was the total cost?

   Total cost = ________________

3. What is the total length of 7 pieces of wiring if each piece is .04 meters long?

   Length in meters = ________________

4. What is the cost of 15 gallons of gasoline at $1.13 per gallon?

   Cost = ________________

5. If spark plugs cost 78¢ each, what is the cost of 2 dozen plugs?

   Cost = ________________

Measuring and Related Math
Unit 3

Assignment Sheet 12—Divide Decimal Numbers

Name ______________________________ Date ______________

Evaluation criteria **Rating**

Directions have been followed. ______

85% of the questions have been answered correctly. ______

Overall rating ______

Evaluator's comments ______________________________

Introduction

Division with decimals is like division with whole numbers. However, before you begin to divide, you must decide where the decimal point should be placed in the number. Follow the steps outlined below for dividing decimal numbers.

Dividing decimal numbers

1. Set up the problem as for division of whole numbers.

   Example: Divide 0.25 by 0.005.

   Divisor $0.005\overline{)0.25}$ Original number

2. Move the decimal point in the divisor to the right of the far-right digit in the divisor.

   Example: $0\underbrace{.005.}\overline{)0.25}$

3. Move the decimal point in the original number to the right by the same number of decimal places that you moved the decimal point in the divisor, adding zeros to the original number if necessary.

   Example: $0\underbrace{.005.}\overline{)0\underbrace{.250.}}$

   Note: If you are dividing a decimal number into a whole number, remember that whole numbers have an understood decimal point to the right of the units digit.

   Example: $0.03\overline{)9}$ becomes $0\underbrace{.03.}\overline{)9\underbrace{.00.}}$

Assignment Sheet 12

4. Place a decimal point in the answer space directly above the repositioned decimal point in the original number.

   Example:

   $$0\underbrace{.005.}\overline{)0\underbrace{.250.}}$$

5. Divide as for whole numbers.

   Example:

   $$\begin{array}{r} 50. \\ 0005.\overline{)0250.} \\ \underline{025} \\ 00 \end{array}$$

6. Check your division by multiplying the original divisor (before the decimal point was moved) by your answer and adding any remainder to this number.

   Note: If you have solved the problem correctly, your check answer should be the same as the original number.

   Example:

	0.005	Divisor
	x 50	Answer
	0.250	Check answer (same as original number)

Exercise

Directions This assignment sheet is divided into two parts. Read each part, and then, answer the questions in each part.

Part A Set up the following problems for division and divide accurately, placing the decimal in the correct position. Show your work in the spaces provided. Write your answers on the blanks.

1. 4.5 ÷ 0.5 = ________________

2. 4.96 ÷ 0.4 = ________________

3. 0.125 ÷ 0.25 = ________________

Assignment Sheet 12

4. 1.7608 ÷ 0.0062 = ____________________

5. 19.8 ÷ 0.6 = ____________________

6. 10.71 ÷ 0.07 = ____________________

7. 0.225 ÷ 0.15 = ____________________

8. 0.48 ÷ 0.6 = ____________________

9. 108 ÷ 0.09 = ____________________

10. 75 ÷ 0.03 = ____________________

Assignment Sheet 12

Part B Solve the following word problems. Show your work in the spaces provided. Write your answers on the blanks.

1. A shipment of 114 identical parts has arrived at the technology education laboratory. The instructor pays the carrier $544.98 for all of them. How much does 1 part cost?

   Cost of part = ________________

2. If a kilo of lubricant costs $7.95, how many kilos may be bought for $47.70?

   Number of kilos = ________________

3. If a person can service 32 batteries in 3.9 days, how many batteries can be serviced in 1 day?

   Number of batteries serviced in 1 day = ________________

4. How many lab projects can be completed in 21.12 hours if the average lab project takes 0.66 hours?

   Number of projects completed = ________________

5. How many hours did a person work if the person was paid a total of $681.75 at the rate of $22.50 per hour?

   Total hours worked = ________________

Measuring and Related Math
Unit 3

Assignment Sheet 13—Convert Fractions to Decimals

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	______
85% of the questions have been answered correctly.	______
Overall rating	______

Evaluator's comments ______________________________

____

____

Introduction

Exact measurements may require a greater degree of accuracy than that which can be measured with a fractional part of an inch. When specifications are given in hundredths, thousandths, and ten thousandths of a unit, the technology education student must understand equivalent decimals.

Converting fractions to decimals

To convert a fraction to a decimal, simply divide the numerator by the denominator.

Examples: Convert $\frac{3}{5}$ to a decimal.

$5\overline{)3}$

$$\begin{array}{r} .6 \\ 5\overline{)3.0} \\ \underline{3\,0} \\ 0 \end{array}$$

Convert $\frac{1}{3}$ to a decimal.

$3\overline{)1}$

$$\begin{array}{r} .33 \\ 3\overline{)1.00} \\ \underline{9} \\ 10 \\ \underline{9} \\ 1 \end{array}$$

Assignment Sheet 13

Any fraction that has a denominator of 10, 100, 1000, 10,000, or any other value that is obtained by multiplying 10 by itself a specified number of times is called a *decimal fraction*. To convert a decimal fraction to a decimal, simply count the number of zeros in the denominator, place a decimal that number of spaces to the left in the numerator (you will have to add zeros in some cases), and delete the denominator.

Example: Convert $5\ \frac{7}{10}$ to a decimal.

Since there is 1 zero in the denominator, you would move the decimal in the numerator one space to the left to get 5.7.

Sometimes you may want to round off a decimal number. To round off a decimal number, follow the steps outlined below.

Rounding decimal numbers

1. Find the place that you are rounding to.

   Example: $3.3\underline{4}6$ Hundredths

2. If the digit to the right is 5 or more, add 1 to the place that you are rounding to; if it is less than 5, do not add anything.

   Example: $3.3\overset{5}{\cancel{4}}\underline{6}$ Five or more

   Add one.

3. Drop all of the digits to the right of the place that you are rounding to.

   Example: $3.35\_$ Digit dropped

Exercise

Directions This assignment sheet is divided into four parts. Read each part, and then, answer the questions in each part.

Part A Convert each of the following fractions to a decimal. Show your work in the spaces provided. Write your answers on the blanks.

1. $\frac{1}{8}$ = ________
2. $\frac{1}{4}$ = ________
3. $\frac{1}{16}$ = ________
4. $\frac{3}{32}$ = ________

Assignment Sheet 13

5. $\frac{1}{2}$ = ________

6. $\frac{3}{4}$ = ________

7. $\frac{5}{8}$ = ________

8. $\frac{7}{8}$ = ________

Part B Match the decimal numbers on the right to their equivalent fractions. Write the correct letters on the blanks.

________	1.	$5\frac{6}{10}$	a.	7.083
________	2.	$1\frac{2}{100}$	b.	5.006
________	3.	$\frac{87}{1000}$	c.	78.3
________	4.	$7\frac{83}{1000}$	d.	0.087
________	5.	$5\frac{6}{100}$	e.	0.783
________	6.	$5\frac{6}{1000}$	f.	87.7
________	7.	$78\frac{3}{10}$	g.	5.6
________	8.	$87\frac{7}{10}$	h.	102.0
________	9.	102	i.	5.06
________	10.	$\frac{783}{1000}$	j.	1.02

Part C Write decimal equivalents for each of the following fractions.

1. $63\frac{9}{10}$ = ____________________
2. $5\frac{93}{100}$ = ____________________
3. $5\frac{93}{1000}$ = ____________________
4. $5\frac{93}{10000}$ = ____________________
5. $3\frac{825}{1000}$ = ____________________
6. $38\frac{95}{100}$ = ____________________
7. $38\frac{95}{1000}$ = ____________________
8. $42\frac{3}{10}$ = ____________________

Assignment Sheet 13

9. 402 $^{3}/_{10}$ = ____________________

10. 897 $^{97}/_{1000}$ = ____________________

Part D Note: This symbol— ≐ —means "is about equal to."

Round these decimals to the nearer:

Tenth

1. 2.36 ≐ ____________________
2. 4.23 ≐ ____________________
3. 2.06 ≐ ____________________
4. 4.109 ≐ ____________________
5. .072 ≐ ____________________

Hundredth

1. 14.023 ≐ ____________________
2. .067 ≐ ____________________
3. 1.089 ≐ ____________________
4. .4209 ≐ ____________________
5. 73.9029 ≐ ____________________

Thousandth

1. 5.0618 ≐ ____________________
2. 8.8397 ≐ ____________________
3. 8.0552 ≐ ____________________
4. 5.0168 ≐ ____________________
5. 78.0999 ≐ ____________________

Assignment Sheet 13

Complete the chart below by rounding these decimals to the places named.

	Tenth	Hundredth	Thousandth
2.8354	2.8		
4.6215			
.2918			.292
.2065			
.1853		.19	
5.6356			
2.1523			
4.6652			

Measuring and Related Math
Unit 3

Assignment Sheet 14—Read U.S. Customary and Metric Rules

Name ______________________ Date ______________

Evaluation criteria	Rating
Directions have been followed.	______
85% of the questions have been answered correctly.	______
Overall rating	______

Evaluator's comments ______________________________

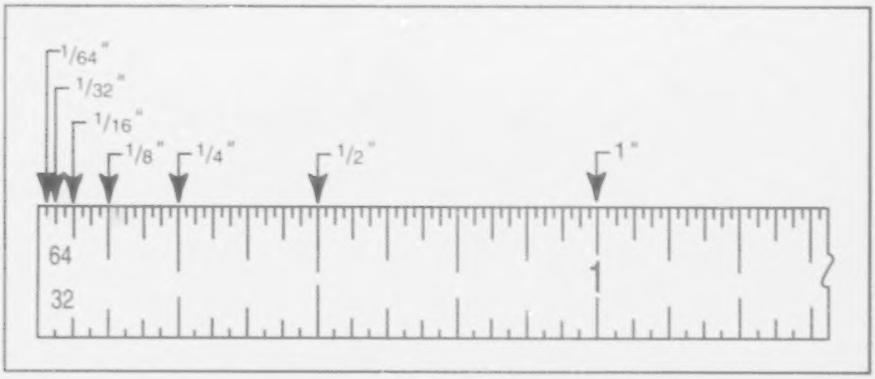
Introduction

American industry is changing from the U.S. customary system to the metric system. For this reason, you will find U.S. customary/metric steel rules with an inch scale on one edge (graduated in sixteenths, thirty-seconds, or sixty-fourths) and a centimeter scale on the other side (graduated in millimeters). You must work with decimals and fractions to make accurate measurements with metric and inch rules.

Reading fractional measurements on a U.S. customary rule

Note: All rules are read similarly. However, some rules are graduated with more divisions than others. The enlarged rule illustrated in Figure 1 is graduated in sixty-fourths of an inch on the top scale and thirty-seconds of an inch on the bottom scale. The staggered graduations are for halves, quarters, eighths, sixteenths, thirty-seconds, etc.

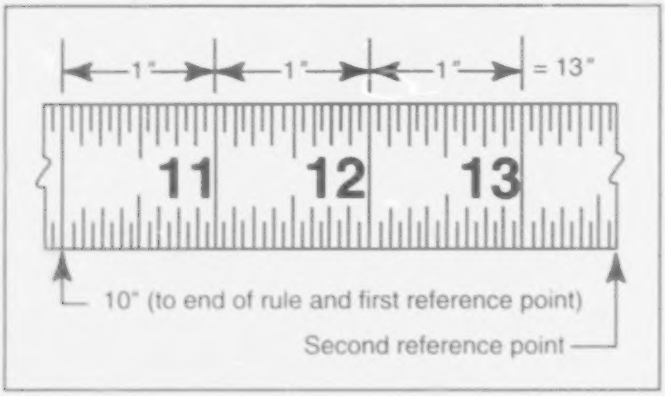
Figure 1



Assignment Sheet 14

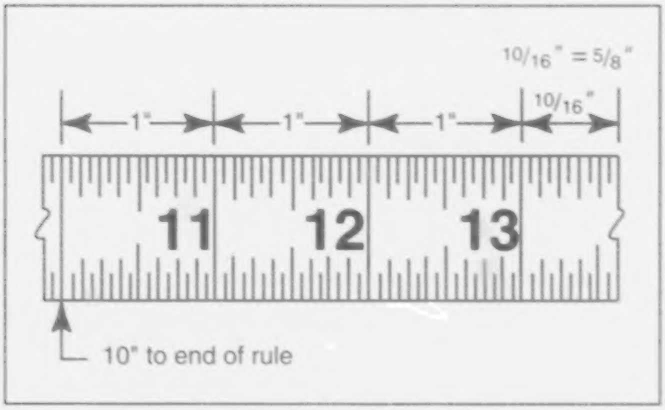
1. Align the end of the rule with one reference point.
2. Determine the number of whole units between the end of the rule and the second reference point. (See Figure 2.)

Figure 2


1"
1"
1"
= 13"
11
12
13
10" (to end of rule and first reference point)
Second reference point

3. Determine the number of fractional units between the last whole unit and the second reference point by counting the divisions.
4. Place this number over the rule scale (the rule in Figure 3 below is scaled in sixteenths of an inch) and reduce this fraction if possible.

Figure 3

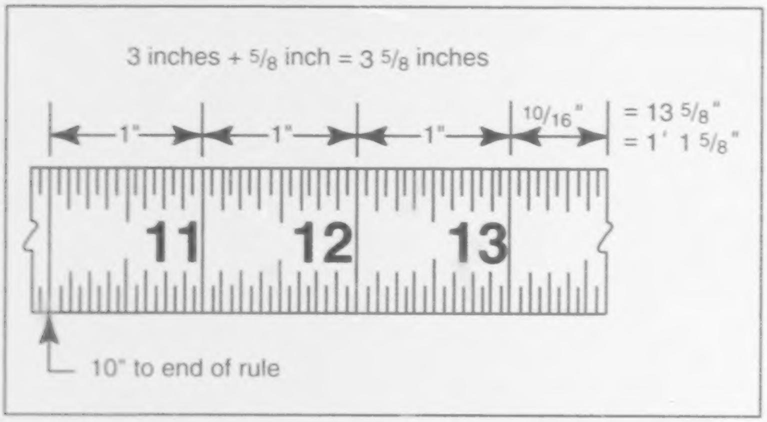

10/16" = 5/8"
1"
1"
1"
10/16"
11
12
13
10" to end of rule

Assignment Sheet 14

5. Make a mixed fraction by adding this reduced fraction to the number of whole units counted earlier; convert inches to feet if necessary by dividing 12 into the total whole inches measured. (See Figure 4.)

Example: 3 inches + ⅝ inch = 3 ⅝ inches

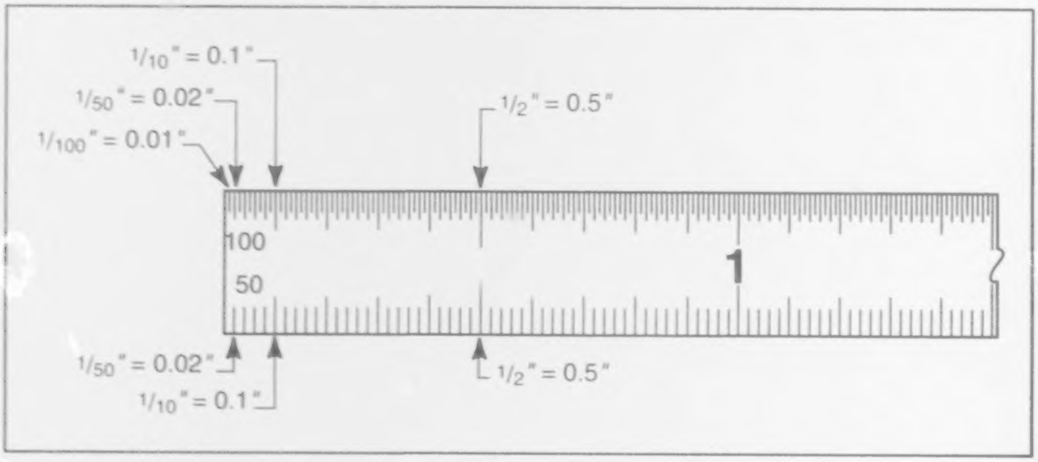
Figure 4


3 inches + 5/8 inch = 3 5/8 inches
1"
1"
1"
10/16"
= 13 5/8"
= 1' 1 5/8"
11
12
13
10" to end of rule

Reading decimal-inch measurements on a U.S. customary rule

Note: U.S. customary rules with decimal-inch increments allow for more precise measurements. The top scale on the enlarged rule illustrated in Figure 5 below is graduated in one-hundredths of an inch (0.01 inch). The bottom scale is graduated in fiftieths of an inch (0.02 inch). The staggered graduations are for halves, tenths, and fiftieths.

Figure 5

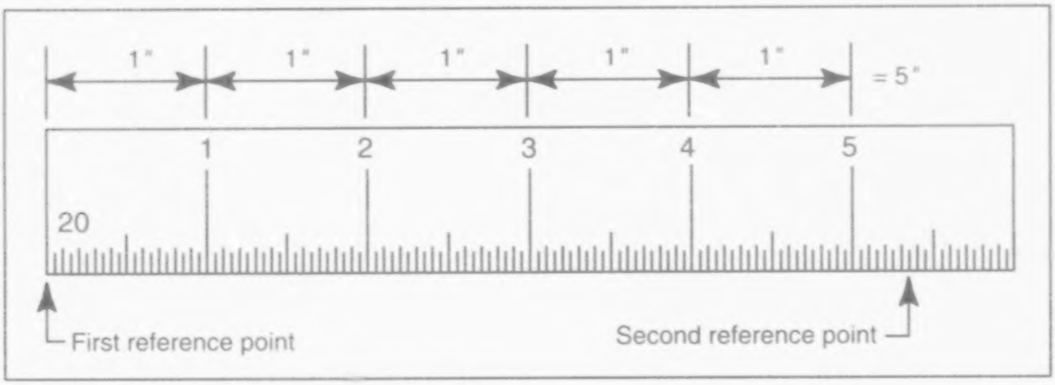

1/10" = 0.1"
1/50" = 0.02"
1/100" = 0.01"
1/2" = 0.5"
100
50
1
1/50" = 0.02"
1/10" = 0.1"
1/2" = 0.5"

Assignment Sheet 14

1. Align the end of the rule with one reference point.
2. Determine the number of whole units between the end of the rule and the second reference point.

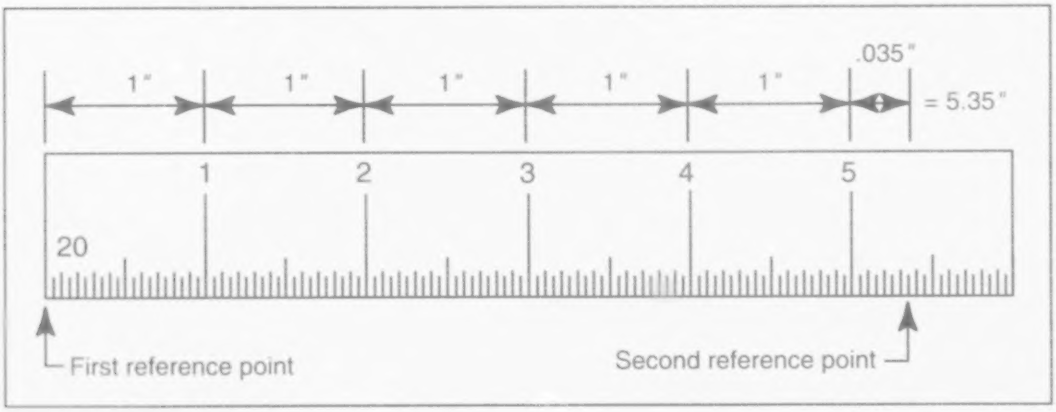
   Note: The rule illustrated in Figure 6 is graduated in twentieths of an inch.

Figure 6


1"
1"
1"
1"
1"
= 5"
1
2
3
4
5
20
First reference point
Second reference point

3. Count the number of graduations (twentieths, 0.05 inch) between the last whole unit and the second reference point.
4. Add this decimal fraction to the number of whole units counted earlier. (See Figure 7.)

Figure 7


.035"
1"
1"
1"
1"
1"
= 5.35"
1
2
3
4
5
20
First reference point
Second reference point

Reading a metric rule

Note: Metric steel rules are available in a range from 150 millimeters to 1000 millimeters (1 meter) in length. The smallest graduation is 0.5 millimeter.

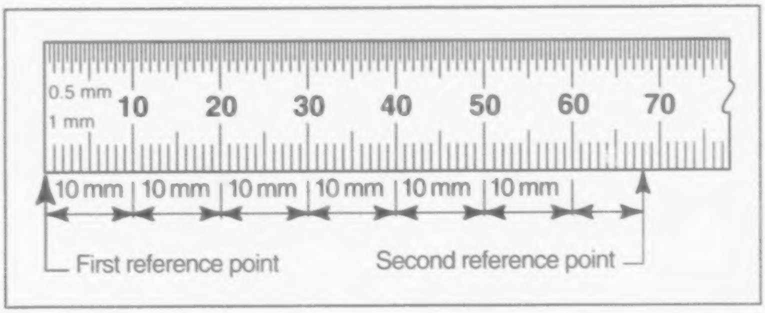
Assignment Sheet 14

1. Align the end of the rule with one reference point.

2. Determine the number of whole units between the end of the rule and the second reference point.

   Note: The enlarged metric rule illustrated in Figure 8 below is graduated in half millimeters (0.5) on the top and whole millimeters (1 mm) on the bottom scale.

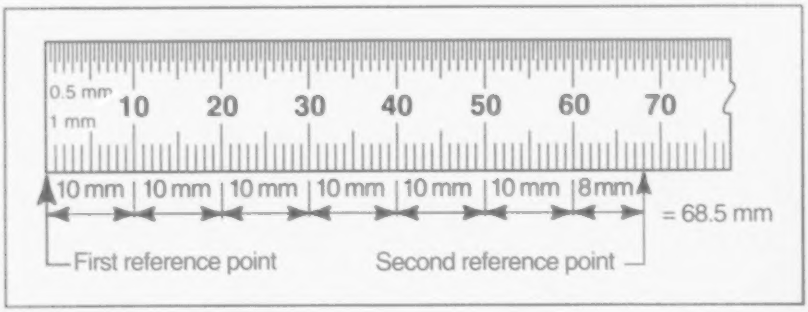
Figure 8


0.5 mm
1 mm
10
20
30
40
50
60
70
10 mm
10 mm
10 mm
10 mm
10 mm
10 mm
First reference point
Second reference point

3. Count the number of graduations (single and half millimeters) between the last whole unit and the second reference point.

4. Add this number to the number of whole units counted earlier. (See Figure 9.)

Figure 9


0.5 mm
1 mm
10
20
30
40
50
60
70
10 mm
10 mm
10 mm
10 mm
10 mm
10 mm
8mm
= 68.5 mm
First reference point
Second reference point

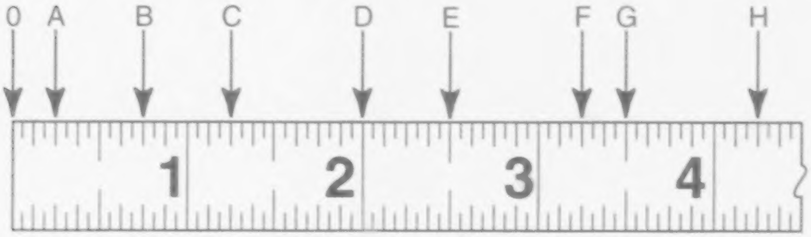
Exercise

Directions This assignment sheet is divided into three parts. Read each part, and then, answer the questions in each part.

Assignment Sheet 14

Part A

1. Read the U.S. customary rule illustrated below to the nearest quarter inch. Write your answers on the blanks provided.



a. 0 to A = ______

b. A to B = ______

c. 0 to C = ______

d. A to D = ______

e. B to D = ______

f. 0 to E = ______

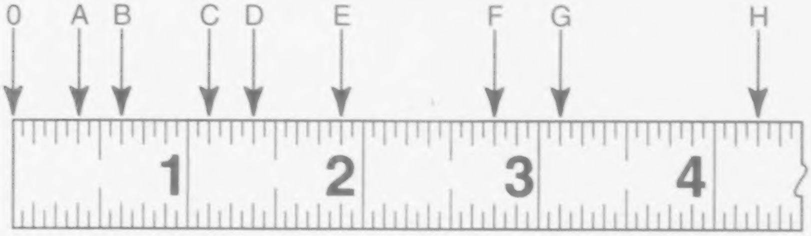
g. C to E = ______

h. B to F = ______

i. D to G = ______

j. A to H = ______

2. Read the U.S. customary rule illustrated below to the nearest eighth inch. Write your answers on the blanks provided.



a. 0 to A = ______

b. A to B = ______

c. 0 to C = ______

d. B to D = ______

e. A to E = ______

f. 0 to F = ______

g. D to E = ______

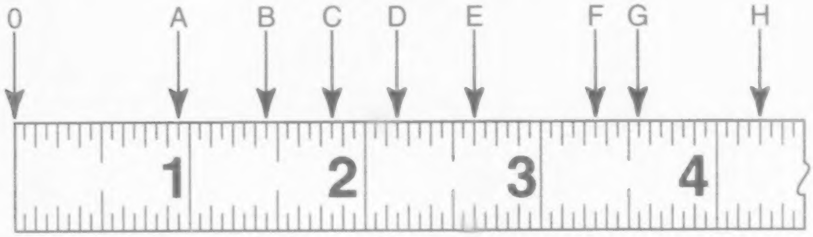
h. C to G = ______

i. 0 to H = ______

j. E to H = ______

Assignment Sheet 14

3. Read the U.S. customary rule illustrated below to the nearest sixteenth inch. Write your answers on the blanks provided.



a. 0 to A = ________

b. A to B = ________

c. 0 to C = ________

d. B to D = ________

e. A to E = ________

f. 0 to F = ________

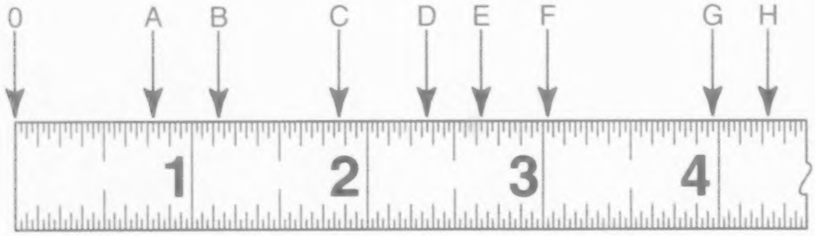
g. C to F = ________

h. A to G = ________

i. 0 to H = ________

j. E to H = ________

4. Read the U.S. customary rule illustrated below to the nearest one thirty-second of an inch. Write your answers on the blanks provided.



a. 0 to A = ________

b. 0 to B = ________

c. A to B = ________

d. 0 to C = ________

e. A to D = ________

f. B to E = ________

g. C to F = ________

h. B to G = ________

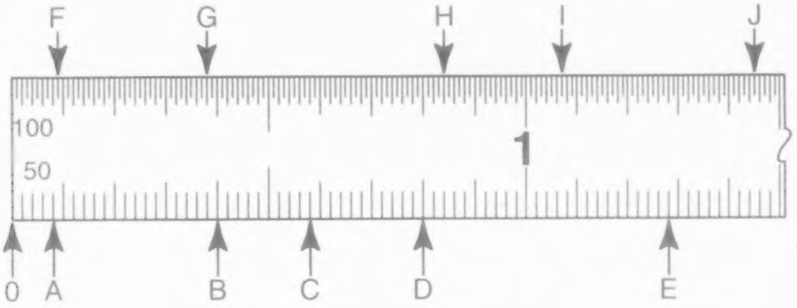
i. 0 to H = ________

j. D to H = ________

Assignment Sheet 14

Part B

1. Read the U.S. customary rule with decimal graduations in fiftieths and hundredths shown below. Write your answers on the blanks provided.



a. 0 to A = ________

b. 0 to B = ________

c. 0 to C = ________

d. 0 to D = ________

e. 0 to E = ________

f. 0 to F = ________

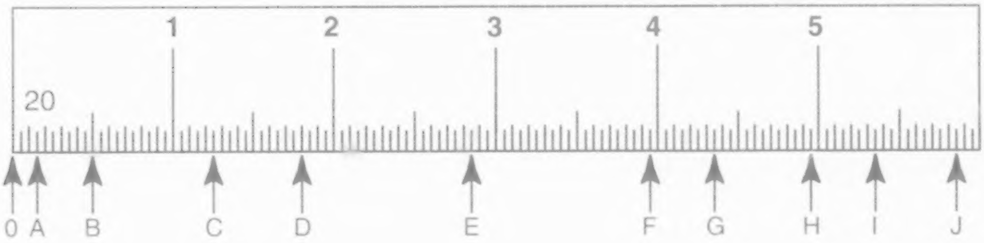
g. 0 to G = ________

h. 0 to H = ________

i. 0 to I = ________

j. 0 to J = ________

2. Read the U.S. customary rule with decimal graduations in twentieths shown below. Write your answers on the blanks provided.



a. 0 to A = ________

b. 0 to B = ________

c. 0 to C = ________

d. 0 to D = ________

e. 0 to E = ________

f. 0 to F = ________

g. 0 to G = ________

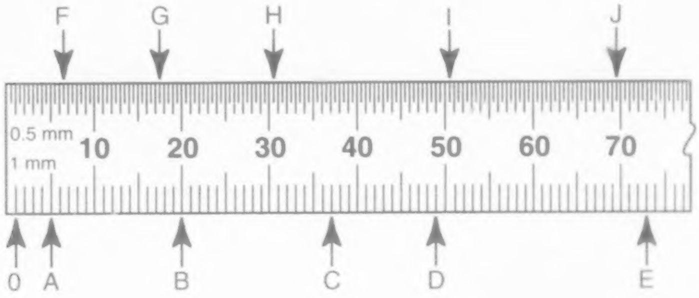
h. 0 to H = ________

i. 0 to I = ________

j. 0 to J = ________

Assignment Sheet 14

Part C Read the enlarged metric rule with 1-millimeter and 0.5-millimeter graduations shown below. Write your answers on the blanks provided.


F
G
H
I
J
0.5 mm
1 mm
10
20
30
40
50
60
70
0
A
B
C
D
E

1. 0 to A = ________
2. 0 to B = ________
3. 0 to C = ________
4. 0 to D = ________
5. 0 to E = ________
6. 0 to F = ________
7. 0 to G = ________
8. 0 to H = ________
9. 0 to I = ________
10. 0 to J = ________

Measuring and Related Math
Unit 3

Student Supplement 2—Metric/U.S. Customary Decimal Equivalents for Fractional Parts of an Inch

Fraction	Decimal equivalent		Fraction	Decimal equivalent	
	Customary (in.)	Metric (mm)		Customary (in.)	Metric (mm)
1/64	.015625	0.3969	33/64	.515625	13.0969
1/32	.03125	0.7938	17/32	.53125	13.4938
3/64	.046875	1.1906	35/64	.546875	13.8906
1/16	.0625	1.5875	9/16	.5625	14.2875
5/64	.078125	1.9844	37/64	.578125	14.6844
3/32	.09375	2.3813	19/32	.59375	15.0813
7/64	.109375	2.7781	39/64	.609375	15.4781
1/8	.1250	3.1750	5/8	.6250	15.8750
9/64	.140625	3.5719	41/64	.640625	16.2719
5/32	.15625	3.9688	21/32	.65625	16.6688
11/64	.171875	4.3656	43/64	.671875	17.0656
3/16	.1875	4.7625	11/16	.6875	17.4625
13/64	.203125	5.1594	45/64	.703125	17.8594
7/32	.21875	5.5563	23/32	.71875	18.2563
15/64	.234375	5.9531	47/64	.734375	18.6531
1/4	.250	6.3500	3/4	.750	19.0500
17/64	.265625	6.7469	49/64	.765625	19.4469
9/32	.28125	7.1438	25/32	.78125	19.8438
19/64	.296875	7.5406	51/64	.796875	20.2406
5/16	.3125	7.9375	13/16	.8125	20.6375
21/64	.328125	8.3384	53/64	.828125	21.0344
11/32	.34375	8.7313	27/32	.84375	21.4313
23/64	.359375	9.1281	55/64	.859375	21.8281
3/8	.3750	9.5250	7/8	.8750	22.2250
25/64	.390625	9.9219	57/64	.890625	22.6219
13/32	.40625	10.3188	29/32	.90625	23.0188
27/64	.421875	10.7156	59/64	.921875	23.4156
7/16	.4375	11.1125	15/16	.9375	23.8125
29/64	.453125	11.5094	61/64	.953125	24.2094
15/32	.46875	11.9063	31/32	.96875	24.6063
31/64	.484375	12.3031	63/64	.984375	25.0031
1/2	.500	12.7000	1	1.000	25.4000

Measuring and Related Math
Unit 3

Assignment Sheet 15—Compute U.S. Customary/Metric Equivalents

Name ______________________ Date ____________

Evaluation criteria	**Rating**
Directions have been followed.	______
85% of the questions have been answered correctly.	______
Overall rating	______

Evaluator's comments ______________________________

Introduction

In the U.S. customary system of measurement, coversions from one unit to another are difficult because the units are so different. There are 5280 feet in a mile, 16 ounces in a pound, 2 cups in a pint, and 36 inches in a yard. Also, the units of measure are not easily related to each other. *One* gallon of water, for instance, weighs 8.345 pounds. In the metric system, however, the measurement units are all powers of ten, and units are all easily related to each other. *One* liter of water, for instance, weighs *one* kilogram.

Converting from one metric unit to another

To convert from one metric unit to another, divide by 10, 100, 1000, etc. Because these conversion factors are all powers of 10, you can simply move the decimal point to the right or left instead of actually dividing or multiplying. Use the diagrams below to help you convert from one metric unit to another.

$$\text{km} \xleftrightarrow{3} \text{m} \xleftrightarrow{2} \text{cm} \xleftrightarrow{1} \text{mm}$$

Examples: To change meters to centimeters, move the decimal point two places to the right: 5.2 m = 520 cm.

To change millimeters to meters, move the decimal point 1 + 2, or 3 places to the left: 63 mm = .063 m.

$$\text{kL} \xleftrightarrow{3} \text{L} \xleftrightarrow{2} \text{cL} \xleftrightarrow{1} \text{mL}$$

Assignment Sheet 15

Examples: To change liters to kiloliters, move the decimal point 3 places to the left: 560 L = .56 kL.

To change liters to milliliters, move the decimal point 2 + 1, or 3 places to the right: 7.6 L = 7600 mL.

Exercise To convert from U.S. customary to metric or metric to U.S. customary units of measure, use the conversion table in Student Supplement 3.

Directions Use the models above, the conversion table in Student Supplement 3, and your knowledge of basic math to compute the following problems.

Part A Fill in the missing numbers.

1. 4700 mL = ________ L
2. 8.2 kL = ________ L
3. 17,000 mL = ________ L
4. .036 km = ________ cm
5. 586 mm = ________ m
6. 784 m = ________ km
7. .0042 L = ________ mL
8. 43.6 cm = ________ m

Part B Tell whether you would use milliliters, liters, or kiloliters to measure each of the following items.

________________ 1. A can of brake fluid

________________ 2. Oil in a lawnmower

________________ 3. Amount of paint for refinishing a motorcycle

________________ 4. Water in a car's cooling system

________________ 5. A dose of medicine

________________ 6. Annual gas consumption in the United States

________________ 7. The amount of air in a tire

________________ 8. A teaspoon of grease

________________ 9. Cleaning solution used by a repair shop in a week

________________ 10. Engine crankcase capacity

Assignment Sheet 15

Part C Tell whether you would use millimeters, meters, centimeters, or kilometers to measure the following items.

________ 1. Bolt size

________ 2. Distance traveled in a month

________ 3. Floor area in the lab

________ 4. Length of a piece of chalk

________ 5. Respirator strap size

Part D Use the conversion table formulas in Student Supplement 3 to convert the following U.S. customary units to metric units of measure.

1. 14 gallons of gas = ________ L
2. 1.5 quarts of oil = ________ L
3. 20 pound-inches = ________ N-m
4. 10 miles = ________ km
5. 32 miles/gallon = ________ km/L
6. 2 yards = ________ m
7. 7 feet = ________ m
8. 1 ¾ inch = ________ mm
9. 180 horsepower = ________ kW
10. 60 miles per hour = ________ km/h

Part E Solve the following word problems.

1. An engine running at a constant speed uses 140 milliliters of gasoline per minute. How many liters of gasoline are used in 7 hours?

   Answer = ________ L

2. A component measures 993 millimeters. You need three such components and must place your order in total inches. How many inches would you order? What would be your order expressed in feet and decimal inches?

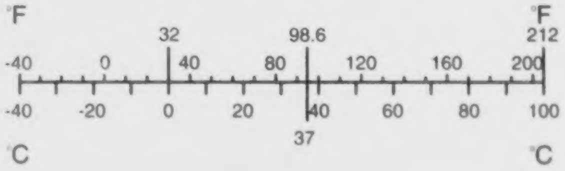
   Answer = ________ inches

   Answer = ________ feet ________ inches

Measuring and Related Math
Unit 3

Student Supplement 3—Metric/U.S. Customary Converstion Table

Multiply	by	to get equivalent number of:
	LENGTH	
Inch	25.4	millimeters (mm)
Foot	0.304	meters (m)
Yard	0.914	meters
Mile	1.609	kilometers (km)
	AREA	
Inch^2	645.2	millimeters^2 (mm^2)
	6.45	centimeters^2 (cm^2)
Foot^2	0.092	meters^2 (m^2)
Yard^2	0.836	meters^2
	VOLUME	
Inch^3	16387.	mm^3
	16.387	cm^3
	0.016	liters (l)
Quart	0.946	liters
Gallon	3.785	liters
Yard^3	0.764	meters^3 (m^3)
	MASS	
Pound	0.453	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	tonne (t)
	FORCE	
Kilogram	9.807	newtons (N)
Ounce	0.278	newtons (N)
Pound	4.448	newtons (N)
	TEMPERATURE	
Degree Fahrenheit	(°F–32) ÷ 1.8	degree Celsius (C)



Multiply	by	to get equivalent number of:
	ACCELERATION	
Foot/sec^2	0.304	meter/sec^2 (m/s^2)
Inch/sec^2	0.025	meter/sec^2 (m/s^2)

Student Supplement 3

Metric/U.S. Customary Conversion Table (continued)

Multiply	by	to get equivalent number of:
TORQUE		
Pound-inch	0.112	newton-meters (N-m)
Pound-foot	1.355	newton-meters (N-m)
POWER		
Horsepower	0.746	kilowatts (kW)
PRESSURE OR STRESS		
Inches of mercury	3.377	kilopascals (kPa)
Pounds/sq in.	6.895	kilopascals (kPa)
ENERGY OR WORK		
BTU	1055.	joules (J)
Foot-pound	1.355	joules (J)
Kilowatt-hour	3600000. or 3.6 x 10^6	joules (J = one Ws)
LIGHT		
Foot candle	10.764	lumens/meter^2 (lm/m^2)
FUEL PERFORMANCE		
Miles/gal	0.425	kilometers/liter (km/l)
Gal/mile	2.352	liters/kilometer (l/km)
VELOCITY		
Miles/hour	1.609	kilometer/hr (km/h)

Thinking Skills
Unit 4

Objective Sheet

Unit objective

After completing this unit, the student should be able to define the aspects of creative thinking and logical thinking and analyze how these aspects are used by students in technology education. The student will demonstrate these competencies by completing the assignment sheets and lab activity sheets and by scoring a minimum of 85 percent on the written test.

Specific objectives

After completing this unit, the student should be able to

1. Define the major types of thinking skills.
2. Distinguish between definitions of the aspects of creative thinking.
3. Distinguish between definitions of the aspects of logical thinking.
4. Use the tools for understanding the creative process to analyze the nature of a recent innovation. (Assignment Sheet 1)
5. Use the tools of logical thinking to analyze a situation. (Assignment Sheet 2)
6. Apply the problem-solving process to improve the quality of a product or service. (Assignment Sheet 3)
7. Create and construct a device that will extinguish a candle flame. (Lab Activity Sheet 1)
8. Create and construct a vessel that will float and bear weight. (Lab Activity Sheet 2)

Thinking Skills
Unit 4

Information Sheet

1. **Major types of thinking skills and their definitions**

    - **Creative thinking**—Process of imagining and producing original methods and tools for understanding the world and dealing with it

    - **Logical thinking**—Process of gathering factual evidence, analyzing it, and evaluating it

2. **Aspects of creative thinking and their definitions**

    - **Innovation**—Two-stage process consisting first of *invention* and second of *application*

      Note: *Invention* is "the act of imagining and giving existence to a new product/service or to an improvement in an existing product/service." *Application* is "the act of putting a product/service to practical use." Recognizing the usefulness of or need for a new product/service can be as creative as inventing it. The two types of creativity involved are different, but equally important in innovation.

    - **Intuition**—Ability to make quick, accurate judgments without factual evidence or, sometimes, contradictory to the factual evidence

      Note: Because creative thinkers deal with new ventures and innovations, they often find themselves in uncharted territory and must rely on intuitive skills to make decisions.

3. **Aspects of logical thinking and their definitions**

    - **Analysis**—Process of breaking down an object, process, or theory into its basic parts in order to understand it

    - **Evaluation**—Process of determining the relative merits and weaknesses of an object, process, or theory

      Note: Evaluation is not restricted solely to finding faults. True evaluation is concerned equally with finding strengths as well as weaknesses.

      Note: Inductive thinking, deductive thinking, the scientific method, divergent thinking, convergent thinking, and the problem-solving process are all tools used in analysis and evaluation.

Thinking Skills
Unit 4

Assignment Sheet 1—Use the Tools for Understanding the Creative Process to Analyze the Nature of a Recent Innovation

Name ______________________________ Date ______________

Evaluation criteria	Rating
Directions have been followed.	______
Content of information provided in essay is relevant, well thought out, and reflects knowledge of the information presented in Student Supplements 1 through 3.	______
Overall rating	______

Evaluator's comments ____

____

____

Introduction

"There is nothing new under the sun."

If that maxim is true, then where do inventions come from? Many theorists contend that inventions are simply new combinations of existing objects or ideas. For instance, in-line roller skates—an invention that now seems obvious—do not include anything really new. Instead, they combine in a new way the existing designs of roller skates with wheels on four corners and of ice skates with a single blade.

Another example is the mountain bike. When mountain bikes were introduced, they seemed to represent a radical departure from existing bicycle designs. In reality, however, they are a clever blend of a racing bike's multiple gears and light weight with an old-fashioned balloon-tire bicycle's comfort and go-anywhere durability.

Many such inventions come from people outside of a business or technology. Like children, who are especially creative because they have not been taught to see barriers that are not really there, outsiders bring fresh perspectives and ideas to solving problems. The people who invented in-line skates and mountain bikes did not know that they couldn't align a skate's wheels in a single row or that they couldn't put derailleur gears on a bicycle with wide tires. In doing so, they shifted the paradigms of what makes a good roller skate or bicycle, and created profitable new markets.

Consider that not long ago everyone knew powered flight was impossible and people would never walk on the moon. Yet because innovative minds refused to acknowledge the generally accepted barriers, both of those dreams are now realities.

Assignment Sheet 1

These are all examples of the creative process at work. The creative process is not a magical thing. It can be understood, and once you understand the process, you can even copy it to create new innovations. Your goal in this exercise is to analyze the creative process behind one recent innovation.

Exercise

Reading assignment

Read the information presented in the following components.

Information sheet

- Objective 1, Major types of thinking skills and their definitions
- Objective 2, Aspects of creative thinking and their definitions

Student supplements

- Student Supplement 1, "Tools for Understanding the Creative Process," on page 153.
- Student Supplement 2, "An Example of How to Analyze the Creative Process," on page 155.
- Student Supplement 3, "Creating Opportunities for Creativity," on page 157.

Activity checklist

Put a checkmark on the blank line before each activity below as you complete it.

_______ 1. Your instructor will divide your class into groups of two, and you and your partner will **collect newspaper and magazine articles** about new innovations in products, services, and businesses. (Your instructor will specify how many articles you will need to collect.) Then, you will work with your instructor to **select one innovation** to analyze.

_______ 2. You and your group partner will **write an essay that analyzes** the nature of your selected innovation. In your essay, you must answer the items in the **Analysis Check** on the next page.

_______ 3. Turn your essay and your newspaper/magazine article in to your instructor for **evaluation**.

_______ 4. Your instructor will return your essay with suggestions for improvement. **Make the improvements** your instructor suggests, and then, return your essay to your instructor for **final evaluation**.

Assignment Sheet 1

Analysis Check

1. What are the name and nature of the innovation?
2. In what specific ways does the innovation differ from previous products, services, or businesses?
3. Does the innovation represent an improvement on an existing paradigm or a paradigm shift? Explain.
4. What additional long-range creative opportunities might result from the innovation?

Thinking Skills
Unit 4

Student Supplement 1—Tools for Understanding the Creative Process

Introduction

Creativity is "the ability to imagine and produce original methods and tools for understanding the world and dealing with it." We can all understand this simple definition of *creativity*, but theorists have found it a little more difficult to describe the creative process in such simple terms.

Theorists have developed the following set of terms and definitions to describe the creative process. These terms may at first seem complicated, but when understood, they will become tools to help you analyze the aspects of the creative process—innovation and intuition.

Paradigm

A *paradigm* is "a set of rules, theories, and expectations that defines the boundaries of a given concept, activity, or field of knowledge and determines acceptable behavior within those boundaries." For example, carburetion is one paradigm for supplying the fuel mixture to internal-combustion engines. Fuel-injection systems function entirely differently and represent a different paradigm for delivering the fuel mixture.

Paradigm shift

A *paradigm shift* is "a change in a given paradigm's basic framework so profound that it creates a new paradigm as opposed to simply altering an existing paradigm." To continue the example of the carburetor, a carburetor's power and performance can be improved by adding more barrels, and also with electronic technology. Improved carburetors still cannot match the reliability and performance of a good fuel-injection system. The change from carburetion to fuel injection is a paradigm shift.

Paradigm shifter or paradigm pioneer

Futurist Joel Barker uses the term *paradigm shifter* to describe "a person whose creative insights and inventions result in a paradigm shift." Barker then uses the term *paradigm pioneer* to describe "a person who recognizes a paradigm shift and introduces it to the marketplace of ideas, products, or services."

A paradigm shifter is involved primarily with invention. A paradigm pioneer is involved primarily with application. For example, the inventor of fuel injection was a paradigm shifter. When fuel injection was first invented, the people who recognized its importance, manufactured it, and promoted it in the automotive marketplace were paradigm pioneers. Few people have the combination of creative talents needed to be both a paradigm shifter and a paradigm pioneer.

Thinking Skills
Unit 4

Student Supplement 2—An Example of How to Analyze the Creative Process

The stirrup

To understand the nature of the creative process and its social impact, consider the lowly stirrup. In the late twentieth century, we take stirrups for granted. But many historians consider the widespread use of stirrups to be among a handful of the most important innovations ever.

The stirrup evidently was invented in India around the second century BC. It is first represented in art from that period and appears as a simple thong that wraps around the rider's big toe. It did not evolve into a loop that encircles the entire foot until some five hundred years later, and it did not reach Europe for another five hundred years after that.

When the stirrup was finally introduced there during the ninth century, Europe already was structured on a rudimentary feudal system with a class of nobility by birth. Until then, however, warfare was generally conducted as hand-to-hand combat by foot soldiers or in sieges. Stirrups gave riders much greater stability in the saddle and enabled them to deliver blows to adversaries with the additional force of their charging mounts.

The new "shock warfare" that resulted gave rise to mounted knights, who gained positions of nobility through their accomplishments in combat. This new class of people brought fresh blood into the nobility's existing ranks and enabled the feudal system to flourish in the late Middle Ages and eventually to blossom into the Renaissance.

Path of innovation

The stirrup's story illustrates the path of most significant innovations. Its inventor likely had no idea of its potential for warfare but was probably simply trying to stay in the saddle when riding for pleasure. Only when someone with a creative mind—perhaps a blacksmith or a soldier—realized the stirrup's full potential was it widely adopted, contributing significantly to one of history's greatest paradigm shifts. Its invention preceded its application by more than a thousand years, and the inventor (paradigm shifter) was long out of the picture by the time the earliest knights (paradigm pioneers) introduced its widespread use.

In each stage of its development, the stirrup likely was introduced by an outsider and initially met with resistance. It definitely was brought to Europe by outsiders, and the first person to use it in combat may well have been an unskilled fighter trying to gain an advantage over more skillful adversaries. Similarly, the first person to convert a leather thong around the toe to a loop of iron around the entire foot probably was an inexperienced rider who had not mastered riding with the more primitive version. Likewise, the inventor of the first big-toe loop probably was an unskilled rider, for an experienced equestrian would have been able to stay in the saddle without stirrups.

That first leather thong looped around the big toe shows how quickly and how firmly a paradigm can take hold. It must have been excruciatingly uncomfortable on a ride of any great length, and it offered little real support. But once that configuration was adopted, two hundred years would pass before some ingenious paradigm shifter redesigned it as the much more practical model that survives basically unchanged today.

Student Supplement 2

At any rate, the inventor of the first stirrup almost certainly took a lot of ribbing for not being able to ride without stirrups—that is, until the inventor finally got tired of it and knocked the scoffers out of their saddles.

Thinking Skills
Unit 4

Student Supplement 3—Creating Opportunities for Creativity

Introduction

Creative individuals have learned to recognize promising ideas when they see them. Knowledgeable individuals also realize that good new ideas rarely come from out of the blue. Like experienced mineral geologists prospecting for gold, they know the likely places to look for potential new products/services and methodically search them out. (They also bear in mind that some of the richest strikes have been discovered in the most unlikely places.) While keeping an eye open for the improbable, they actively seek opportunities among the kinds of products/services listed below.

Opportunity 1

Happy accidents. Many products are discovered quite by accident. Old railroad ties, for instance, had little use until some creative person realized they could be put to excellent use in landscaping. Similarly, an entirely new market was created by the individual who realized that the "useless" four-inch-diameter remnants of logs used to make plywood could be treated and used as "landscape timbers."

Opportunity 2

Updating a forgotten or neglected product or business. The phenomenally successful 1980s board game of "Pente" is an example of a forgotten product. Pente was simply a modernized version of an ancient Greek game that was played with pebbles. An employee at a pizza restaurant recreated it while playing with coins on a checkered table cloth. Another example, diners and drive-in restaurants, which once seemed to be a thing of the past, are making a profitable comeback in many cities.

Opportunity 3

Simplifying an existing product. Personal computers are a good example of simplifying, or "defeaturing," an existing product to make it desirable and affordable for a new market. The mammoth computers of the 1950s, '60s, and '70s could handle enormous tasks of mind-boggling complexity, but they were useless to average people and beyond their reach. The downsized personal computers introduced in the 1980s suddenly made computers accessible to everyone and have forever changed business, education, and society in general—and they have made fortunes for many farsighted individuals.

Opportunity 4

Creating a spinoff. The growing CD-ROM market is representative of creating a "spinoff" product that complements but doesn't compete with an existing product. Rather than trying to design and market an entirely new CD-ROM-based computer system, CD-ROM inventors designed it as an external memory device that could be added to existing personal computer systems. The market for CD-ROMs has now grown to the point that most mid- to upper-range personal computers come with internal CD-ROMs or bays where they can be added.

Opportunity 5

Marketing an existing product. An editor of two western-history magazines relied heavily on a comb-bound, 160-page photocopy of a history buff's compilation of brief biographies of famous Westerners, with directions for reaching their gravesites. After nearly wearing out a personal copy, the editor finally realized there would be a strong market among western-history enthusiasts for a high-quality, clothbound edition of the book. The book was published and has met with great success.

Opportunity 6 **Adding features to or improving an existing product.** The simple western shirt presented a highly profitable opportunity to Maury Tate. Tate's "Mo' Betta" line of western shirts add the features of durable, high-quality fabrics and unique, distinctive designs.

Opportunity 7 **Marketing new technologies.** Think back to the invention of the iron stirrup and how it must have opened a new world of opportunity for its makers. Futurologists predict that the exploding information industry and related technologies will continue to offer great opportunities for entrepreneurs well into the twenty-first century.

Opportunity 8 **Offering a more complete line of goods/services than anyone else.** How often have you wasted time searching for a store that carried an item you needed? Customers will return to the stores that consistently have the goods they need and avoid those that carry only a limited stock or are often out of stock.

Opportunity 9 **Offering greater value than anyone else.** Futurologists predict that as Americans become more value conscious, creative thinkers will continue to find opportunities for offering products/services of exceptional value despite the proliferation of discount houses and mass merchandisers. The coming information age will also allow creative thinkers to personalize products at prices that will be more competitive with those of mass merchandisers.

Opportunity 10 **Offering service, parts, and supplies for an existing product.** You don't have to make or sell cars to earn a living servicing them or supplying parts for them. You don't have to make or sell computers to earn a living as a consultant telling other people how to use them. And you don't have to make or sell copying machines to earn a living supplying paper and toner for them. Make it a habit to stay abreast of new products and to predict opportunities for providing service and supplies.

Thinking Skills
Unit 4

Assignment Sheet 2—Use the Tools of Logical Thinking to Analyze a Situation

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	______
Contents of information provided in student papers is relevant, well thought out, and reflects knowledge of the information presented in Student Supplement 4.	______
Overall rating	______

Evaluator's comments ______________________________

____

____

Introduction

In Assignment Sheet 1, you learned that completing the creative process was not a magical thing—it can be understood and once understood, copied. Effectively utilizing the creative process just takes practice.

Learning to think logically, too, just takes practice. In fact, you are probably already using many of the tools of logical thinking to solve problems you face every day. Your goal in this assignment, then, is to recognize the tools of logical thinking you already practice.

Exercise

Reading assignment

Read the information presented in the following components.

Information sheet

- Objective 1, Major types of thinking skills and their definitions
- Objective 3, Aspects of logical thinking and their definitions

Student supplement

- Student Supplement 4, "Tools of Logical Thinking", on page 161.

ASSIGNMENT SHEET 2

Assignment Sheet 2

Activity checklist

Put a checkmark on the blank line before each activity below as you complete it.

_______ 1. Think of something in your home that you are not happy with—it could be the way a room is arranged, the amount of time it takes you to get dressed and ready for school or work in the morning, or even some aspect of your relationship with another family member. **Write a paper that describes** this problem. Label this paper "Problem Statement."

_______ 2. Brainstorm to determine the cause of the problem, possible solutions, and a plan of action to solve the problem. As you brainstorm, **write** these thoughts **as a list** on another sheet of paper. Label this paper "Problem-Solving Steps."

Then, go back and determine which of the tools of logical thinking described in Student Supplement 4 you used in each problem-solving step. **Label each item in the list.** And, remember, more than one type of thinking might apply to each step.

_______ 3. Turn your "Problem Statement" and "Problem-Solving Steps" papers in to your instructor for **evaluation**.

_______ 4. Your instructor will return your papers with suggestions for improvement. **Make the improvements** your instructor suggests, and then, return your papers to your instructor for final **evaluation**.

Thinking Skills
Unit 4

Student Supplement 4—Tools of Logical Thinking

Introduction

Logical thinking is "the process of gathering factual evidence, analyzing it, and evaluating it." Although logical thinking is described as one process, actually, there are many methods of achieving this process. Some of the terms used to describe different methods used in thinking logically are described below.

Induction

You use *induction*, or *inductive reasoning*, when you arrive at a conclusion about a group by examining its individual members. For example, an arborist might observe a number of aspen trees in the fall. The first aspen the arborist observed would have beautiful gold fall foliage. As the arborist observed more and more aspens, their leaves, too, would be golden. At last, after observing many aspens and seeing none with any other color of fall foliage, the arborist could conclude that all aspen trees turn gold in the fall.

The most common error in inductive reasoning is to overgeneralize; that is, to reach an untrue conclusion about a group based on a sample of too few members of that group. For example, the Mega-Burger franchises in my hometown are all successful; therefore, all Mega-Burger franchises are successful.

Overgeneralization about people, or *stereotyping*, can destroy a person's greatest asset, the ability to work with others. For instance, people who believe that all accountants are dishonest will probably deprive themselves of ever establishing an effective relationship with an accountant, which can be essential to running a successful business.

Deduction

You use *deduction*, or *deductive reasoning*, when you arrive at a conclusion about an individual member of a group according to a premise about that group. The *syllogism* is a good model for deductive reasoning. It consists of a major premise, a minor premise, and a conclusion. For example,

Major premise: All humans are mortal.
Minor premise: Pat is a human.
Conclusion: Pat is mortal.

A syllogism's accuracy depends upon the truth of its premises and on its premises and conclusion being in the correct order. For instance, a syllogism based on the faulty major premise that all humans have two legs would lead to faulty conclusions about people who have only one leg or no legs. Faulty major premises are the result of overgeneralizing. Another example of a faulty syllogism is

Major premise: All humans are mortal.
Minor premise: Pat is mortal.
Conclusion: Pat is human.

Scientific method

The scientific method is a thinking process consisting of five stages:

1. Recognizing a problem.
2. Gathering data relevant to the problem.

3. Stating a *hypothesis*, or possible solution to the problem.
4. Testing the hypothesis.
5. Arriving at a conclusion.

Recognizing a problem and determining a testable hypothesis require intuitive skills, while gathering data, setting up a test, and drawing a conclusion—the distinctive stages of the scientific method—require logical skills. A key aspect of the scientific method is learning from mistakes. For example, an ice-cream maker who thinks that fudge-sundae chocolate-chip ice cream might sell better in a new brown container than it does in the current white one can test-market the new design under closely controlled conditions and compare its sales to those of the existing design.

Divergent thinking

You use divergent thinking when you find more than one answer to a problem. For example, an entrepreneur who opened a cafe might find that the number of customers was not so high as expected. To increase business, the entrepreneur might consider improving service, adding items to the menu, lowering prices, and increasing the business' advertising and publicity programs. In discovering all of those possible answers to the problem, the entrepreneur is thinking divergently.

Convergent thinking

You use convergent thinking when you consider the various possible solutions to a problem and make a decision. For example, in exploring the different ways of increasing business and deciding which solution—or combination of solutions—would be most cost effective and developing a plan of action, the cafe owner would be thinking convergently.

Thinking Skills
Unit 4

Assignment Sheet 3—Apply the Problem-Solving Process to Improve the Quality of a Product or Service

Name ______________________________ Date ______________

Evaluation criteria **Rating**

Directions have been followed. ______

Content of information provided in student papers is relevant, well thought out, and reflect knowledge of the information presented in Student Supplement 5. ______

Overall rating ______

Evaluator's comments ______________________________

____

____

Introduction

In Assignment Sheet 2, you learned that thinking logically just takes some practice and that you are already using many of the tools of logical thinking to solve problems you face every day.

Your goal in this assignment will be to study the formal steps in the problem-solving process, and then, apply those steps to improve the quality of a product or service presently provided by your school.

Exercise

Reading assignment

Read the information presented in the following components.

Information sheet

- Objective 1, Major types of thinking skills and their definitions
- Objective 3, Aspects of logical thinking and their definitions

Student supplement

- Student Supplement 5, "The Problem-Solving Process", on page 165.

Activity checklist

Put a checkmark on the blank line before each activity below and on the next page as you complete it.

______ 1. Your instructor will divide your class into groups of at least two, and you and your partner(s) will **identify a product/service** at your school **that needs to be improved**.

________ 2. **Research** the steps in the present process used to produce this product/service. Then, **write a paper that describes** the product/service you are to improve and **outlines** the present steps in the process used in providing the product/service. Label this paper "Present System."

________ 3. Turn your "Present System" paper in to your instructor for **evaluation**.

________ 4. Your instructor will return your "Present System" paper to you with suggestions for improvement. **Make the improvements** your instructor suggests.

________ 5. Apply the problem-solving process presented in Student Supplement 5 to determine how to improve the steps in the process used to deliver the product/service.

Write a paper that **outlines the steps** in the improved process. Label this paper "Revised System."

________ 6. Turn your "Revised System" paper in to your instructor for **evaluation**.

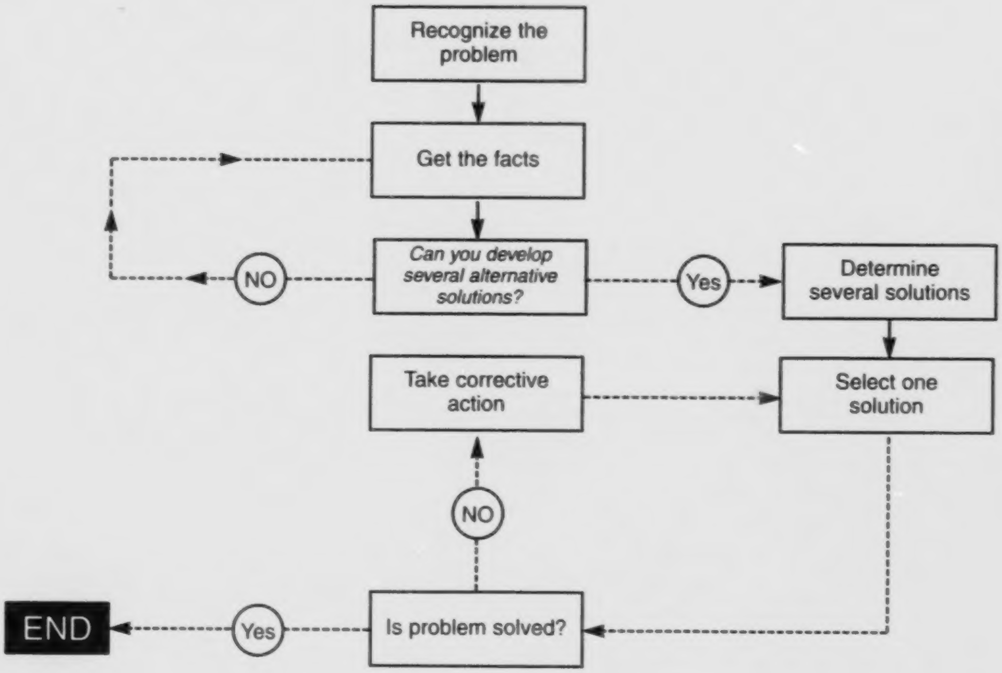
________ 7. Your instructor will return your "Revised System" paper with suggestions for improvement. **Make the improvements** your instructor suggests.

________ 8. Return your "Present System" and "Revised System" papers to your instructor for **final evaluation**.

Thinking Skills
Unit 4

Student Supplement 5—The Problem-Solving Process

Problem-Solving Process


Recognize the problem
Get the facts
Can you develop several alternative solutions?
NO
Yes
Determine several solutions
Select one solution
Take corrective action
NO
Is problem solved?
Yes
END

Thinking Skills
Unit 4

Lab Activity Sheet 1—Create and Construct a Device That Will Extinguish a Candle Flame

Introduction

In Lab Activity Sheet 1 and Lab Activity Sheet 2 you will practice the creative and logical thinking skills you have learned in the information sheet and assignment sheets to create and then construct an original invention to solve the problem set up in each lab activity.

In this lab activity, you will create and construct a device that will extinguish a candle flame. You will accomplish this task by following the guidelines listed in the procedure steps below.

Procedure

Put a checkmark on the blank line before each step below as you complete it.

_______ 1. Your instructor will divide your class into groups of two, and you and your partner will study the rules and regulations for this activity, which are presented below.

Rules and regulations

- Your instructor will provide you with a standard mousetrap and a standard birthday candle. You and your partner must incorporate the mousetrap into the design of a device that will extinguish the flame of the birthday candle.
- The mousetrap is the only source of energy that can be incorporated into the design of the device.
- In your finished design, the mousetrap must be placed 36 inches away from the candle and 6 inches either above or below the candle.
- After the device has been constructed, it will be tested using the following rules:
  - — During the test, the person who operates the device will get only one chance to put out the candle flame. Penalty points will be deducted from the rating for each unsuccessful attempt at operating the device.
  - — The device must extinguish the flame within the limit of the candle's normal life (before the candle burns down and the flame goes out). Penalty points will be deducted from the rating if the candle burns down and the flame goes out before the device extinguishes the flame.

_______ 2. Review the following worksheet associated with this lab activity.

Lab Activity Sheet 1

_______ 3. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the information you have written and the equipment/materials you have listed for performing the procedure.

_______ 4. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

_______ 5. Using the instructor-approved information and equipment/materials list on the worksheet, construct the device.

_______ 6. Test the device. Your instructor will rate your performance using the evaluation criteria listed in Part B on the worksheet.

Lab Activity Sheet 1

Worksheet—Create and Construct a Device That Will Extinguish a Candle Flame

Name ______________________________ Date ____________

Part A: **Pre-performance check**

Complete the following information concerning the design of the device.

- In the space provided below (or on a separate sheet of paper), draw a design of the device you will construct to extinguish the candle flame and write a description of how you believe the device will function.

- In the space below, list special equipment/materials required to construct the device you have designed.

Instructor's signature ______________________________

Lab Activity Sheet 1

Worksheet—Create and Construct a Device That Will Extinguish a Candle Flame

---

Part B: Performance evaluation

Evaluation criteria	**Rating**
Design of the device meets the rules and regulations set for the procedure.	________
Design of the device is creative and unique.	________
Presentation of the design drawing and description of the device is neat, accurate, and well organized visually.	________
During the test, the device functions according to the rules and regulations set in the procedure.	________
Note to evaluator: Penalty points must be deducted if the flame is not extinguished in one attempt or if the candle flame burns out before the device extinguishes the flame.	
Lab clean-up and follow-up actions were satisfactory.	________
Overall rating	________

Evaluator's comments ____

____

____

Thinking Skills
Unit 4

Lab Activity Sheet 2—Create and Construct a Vessel That Will Float and Bear Weight

Introduction In Lab Activity Sheet 1 you practiced the creative and logical thinking skills you have learned in the information sheet and assignment sheets to create and then construct an original invention to solve the problem set up in the lab activity—extinguishing a candle flame.

In this lab activity, you will create and construct a vessel that will float in water and bear weight. You will accomplish this task by following the guidelines listed in the procedure steps below.

Procedure Put a checkmark on the blank line before each step below and on the next page as you complete it.

______ 1. Your instructor will divide your class into groups of two, and you and your partner will study the rules and regulations for this activity, which are presented below.

Rules and regulations

- Your instructor will provide you with the following materials.
  - — Four 3-by-5-inch cards
  - — A 2-foot length of adhesive tape
  - — A 2-inch diameter ball of modeling clay

  You and your partner must incorporate these materials into the design of a vessel that will float in water.
- You and your partner must also incorporate a hollow "cargo compartment" into the design of your vessel.
- After you construct your vessel, it will be tested in a class competition that uses the following rules:
  - — During the test, your instructor will place your vessel in a vat of water and then begin adding pennies to the cargo compartment one at a time until the vessel sinks.
  - — The vessel that can bear the most weight (holds the most pennies) will win the class competition.

______ 2. Review the following worksheet associated with this lab activity.

______ 3. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the information you have listed for performing the procedure.

Lab Activity Sheet 2

________ 4. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

________ 5. Using the instructor-approved information on the worksheet, construct the vessel.

________ 6. Test the vessel. Your instructor will rate your performance using the evaluation criteria listed in Part B on the worksheet.

Lab Activity Sheet 2

Worksheet—Create and Construct a Vessel That Will Float and Bear Weight

Name ______________________________ Date ______________

Part A: Pre-performance check

Complete the following information concerning the design of the vessel.

- In the space provided below (or on a separate sheet of paper), draw a design of the vessel you will construct and write a description of how you believe the vessel will function.

Instructor's signature ______________________________

Lab Activity Sheet 2

Worksheet—Create and Construct a Vessel That Will Float and Bear Weight

---

Part B: **Performance evaluation**

Evaluation criteria	**Rating**
Design of the vessel meets the rules and regulations set for the procedure.	______
Design of the vessel is creative and unique.	______
Presentation of the design drawing and description of the vessel is neat, accurate, and well organized visually.	______
During the test, the vessel functions according to the rules and regulations set in the procedure.	______
Lab clean-up and follow-up actions were satisfactory.	______
Overall rating	______

Evaluator's comments ____

____

____

Career-Exploration Process
Unit 5

Objective Sheet

Unit objective

After completing this unit, the student should be able to develop a plan of action for meeting a career goal. The student will demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the written test.

Specific objectives

After completing this unit, the student should be able to

1. Match terms associated with career exploration to their correct definitions.
2. List the steps in the career-exploration process.
3. Gather personal information. (Assignment Sheet 1)
4. Gather general job information and identify occupational area of choice. (Assignment Sheet 2)
5. Gather specific job information. (Assignment Sheet 3)
6. Make a career decision. (Assignment Sheet 4)
7. Develop a plan of action to meet career goal. (Assignment Sheet 5)

Career-Exploration Process
Unit 5

Information Sheet

1. **Terms and definitions associated with the career-exploration process**

   - **Aptitude**—Talent or potential for being able to do something

   - **Career**—Path a person follows within an occupational area

     Example: Computer operator to computer programmer to computer systems analyst

   - **Interest**—Thing, subject, or activity in life that you like to do or that makes you happy

   - **Job**—Planned or responsible activity a person performs with the expectation of a return for his or her efforts

     Example: Computer operator

   - **Occupational area**—Group of jobs similar according to the nature of the work being performed

     Examples: Communication; construction; manufacturing; energy, power, and transportation

   - **Skill**—Activity you have been trained to do and have practiced doing

     Examples: Typing, math, foreign language, public speaking

   - **Value**—Personal judgment concerning the importance or worth of a thing or quality

2. **Steps in the career-exploration process** (see Figure 1)

Note: In Unit 1, you learned that *technology education* is a "hands-on, laboratory-based educational program that allows students to use problem-solving methods to explore the various systems of technology and the educational and career opportunities available in each system." In this unit, you will learn career-exploration skills that will help you determine the educational and career opportunities available in communication; construction; manufacturing; and energy, power, and transportation as you use those skills to explore these areas in later units in this series of books.

As explained above, learning career-exploration skills will be important in helping you meet the objectives of this educational program. But, your learning these skills will be far more important in helping you meet the objectives of your life. Making a career decision is the first step you should take to ensure that you reach the life-style you want for your future.

Many people just take any job available at the time they go to work, and they never find the career path that would give them the future they want. Such people often have never been taught the steps that would guide them through the process of making careful and logical career decisions. By learning—and then practicing—the following steps, you control the important process whereby you decide your future.

Information Sheet

- **Step 1—Gather personal information** (define your interests, aptitudes, skills, and values).

  Note: During this first step, you should conduct a formal or informal self-inventory to define your present interests, aptitudes, and skills and to ask yourself important questions about your personal values. Where will you want to live? How much time will you want to devote to your job? How much travel will you want to do in your job? How much money will you need?

- **Step 2—Gather general job information.**

  Note: During the information-gathering step, you will locate general information about the occupational areas, and you will become aware of the types of jobs available in the various occupational areas.

- **Step 3—Identify occupational area of choice.**

  Note: During this step, you will identify an occupational area in which the jobs seem to best meet your interests, aptitudes, and skills and also fulfill your values.

- **Step 4—Gather specific job information to compare jobs within an occupational area of choice.**

  Note: At this step, you will locate and compile specific job information for the jobs within the occupational area you have chosen. Specific job information will include duties, working conditions, work requirements, earnings and advancement opportunities, employment outlook, and required educational and training levels of the jobs.

- **Step 5—Make a career decision** (define career goal).

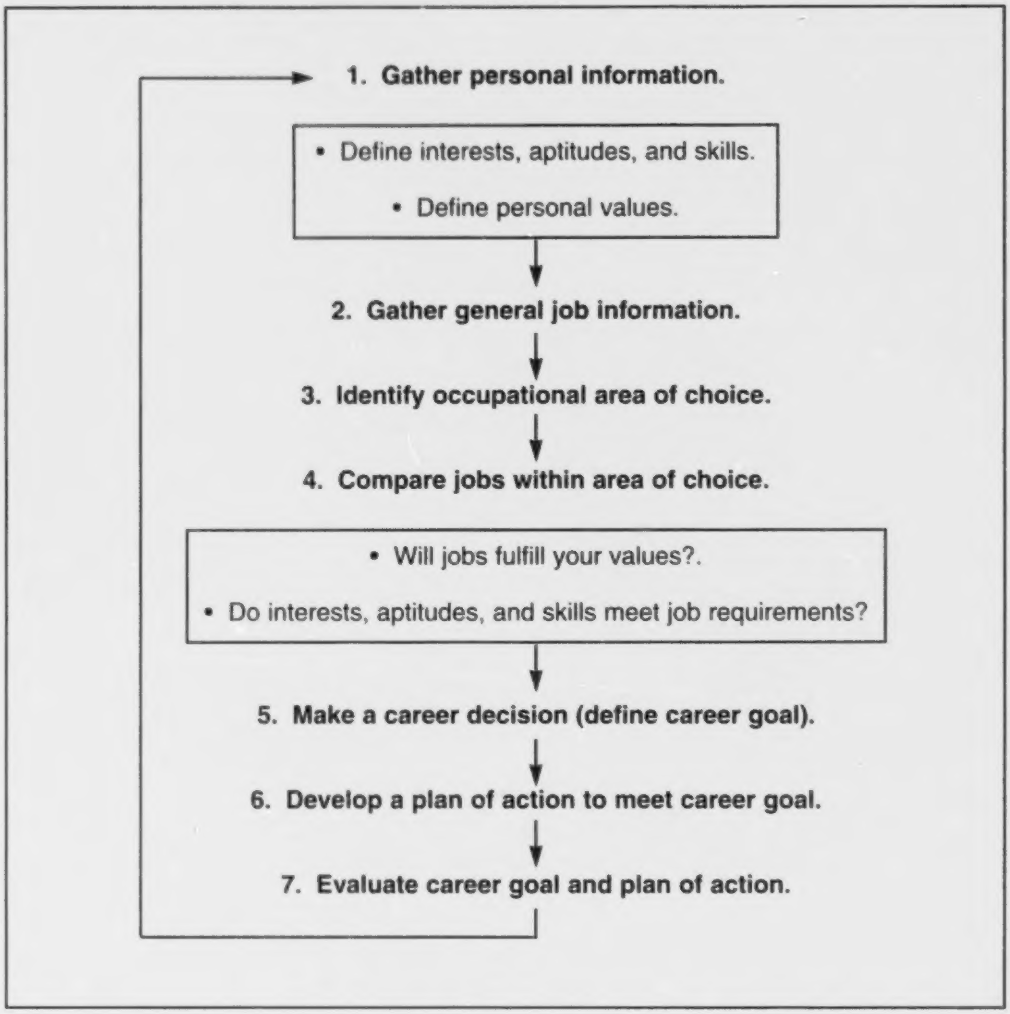
- **Step 6—Develop a plan of action to meet career goal.**

- **Step 7—Evaluate career goal and plan of action.**

  Note: As you grow older, your interests and skills may change and circumstances may require a change in your plan of action. Continue asking yourself questions to determine whether or not this career and plan of action are still appropriate. If you find they are not, begin the career-exploration process again.

Information Sheet

Figure 1: Steps in the career-exploration process



1. **Gather personal information.**
   - Define interests, aptitudes, and skills.
   - Define personal values.
2. **Gather general job information.**
3. **Identify occupational area of choice.**
4. **Compare jobs within area of choice.**
   - Will jobs fulfill your values?.
   - Do interests, aptitudes, and skills meet job requirements?
5. **Make a career decision (define career goal).**
6. **Develop a plan of action to meet career goal.**
7. **Evaluate career goal and plan of action.**

Career-Exploration Process
Unit 5

Assignment Sheet 1—Gather Personal Information

Name ______________________ Date ____________

Evaluation criteria	**Rating**
Directions have been followed.	______
Content is relevant and well thought out.	______
Overall rating	______

Evaluator's comments ______________________________________

Introduction

We all have certain *interests*—things, subjects, or activities in life that we like to do, or things that make us happy. Conversely, we all have certain things, subjects, or activities that we dislike.

We all also have certain *aptitudes*—a talent or potential for being able to do something—and *skills*—activities we know how to perform because we have been trained to do them and have practiced doing them. And, we all hold certain *values*—personal judgments concerning the importance or worth of a thing or quality.

Each occupational area has certain requirements that are necessary in order for a person to be able to perform the jobs within that area successfully. By figuring out your interests, dislikes, aptitudes, skills, and values and then comparing them to the requirements necessary for success in the jobs in the various occupational areas, you can learn much about possible career options you may choose to investigate.

One method you can use to discover your interests, dislikes, aptitudes, skills, and values is an informal self-inventory. Self-inventories often consist of open-ended statements or questions that ask you to examine your preferences in specific areas.

For example, to discover and examine your **interests** and **dislikes**, you might be asked questions such as: Do you prefer to spend your time with people? Or do you prefer to work on problems—maybe by writing, thinking, daydreaming, or reading? Do you spend most of your time tinkering with machines, doing carpentry, cooking, or working on a car? What activities did you enjoy as a child? What courses do you enjoy? What are your hobbies?

Assignment Sheet 1

Such questions can give you clues about your career interests. If you answer that you enjoy courses that include lots of discussions, you might like a job working with people. Or, if you answer that you like to work alone on projects, you might prefer a career that involves working with data or things.

In examining your **aptitudes**, you may be asked questions over three aptitude areas: school-subject, physical, and mental.

Questions that can help you identify your aptitudes in school subjects might include: Which subjects are most enjoyable for you? In which do you receive the best grades? Which subjects are most difficult for you? In which do you receive the poorest grades? A good analysis of your school subjects will provide you with many clues to your aptitudes.

You should also analyze your physical aptitudes, since these affect the type of job for which you should apply. Questions that help you analyze this aptitude area include: Do you have any physical handicaps that prevent you from working in certain occupations? What is your personal energy level? Are you basically healthy? energetic? alert? Do you have enough strength to do certain jobs?

A third aptitude area to examine is your mental capabilities. Can you add, subtract, multiply, and divide numbers easily? Can you work with fractions? Can you communicate effectively and easily?

Skills are often thought of as activities that have to do with manual training. Such skills as typing, sewing, carpentry, repairing an engine, and operating a cash register are easy to identify. However, other skills are also important and should be included in your skills analysis. The following questions can be useful in your skills analysis: Have you had any special training or experience in communication, such as public speaking or debate? Have you had special training in music, such as piano or singing lessons? Have you had special training or experience in working with people such as volunteer work for charitable organizations? What special training have you had in foreign languages, technology education, mathematics, home economics, science, fine arts, etc.? These subjects may have provided you with the skills that are needed for various careers.

You do not think about your **values** a lot. They are usually learned from your parents and you live by them automatically. But, examining your values is an important aspect of making wise decisions that will help you gain more satisfaction from your future job.

Values are things people believe important or worthwhile. The following are nine things that people value and may also affect their job satisfaction.

- High pay
- Security (not having to worry about losing your job)
- Independence (being able to work alone)
- Routine (having a regular way of doing things)

Assignment Sheet 1

- Variety (having many different things to do)
- Authority (having power over others)
- Creativity (being able to use your imagination)
- Respect (feeling important or recognized)
- Contribution to society (being able to change society for the better)

Asking you to rank these nine values has been found to be a good way of helping you examine the work values that are important to you.

Exercise **Self-inventory**

Directions Your goal in this exercise is to get enough information about yourself so that you can define your interests, aptitudes, skills, and values—Step 1 in the career decision-making process. To do so, complete the following five-part self-inventory, then discuss your answers with someone whose opinion you respect.

Section A: Interest inventory

1. Do you like to work with people?

   Yes _______ No _______

2. Do you like to work on mechanical things?

   Yes _______ No _______

3. Do you like to work with facts and figures?

   Yes _______ No _______

4. Do you like to discuss important issues?

   Yes _______ No _______

5. Do you like being outdoors?

   Yes _______ No _______

6. Do you like to read?

   Yes _______ No _______

7. Do you like to write?

   Yes _______ No _______

Assignment Sheet 1

8. What three school subjects have you liked best? Why?

Subject a. ______________________________

Reasons for liking subject ______________________

____

____

Subject b. ______________________________

Reasons for liking subject ______________________

____

____

Subject c. ______________________________

Reasons for liking subject ______________________

____

____

9. What three school subjects have you liked least? Why?

Subject a. ______________________________

Reasons for disliking subject ____________________

____

____

Subject b. ______________________________

Reasons for disliking subject ____________________

____

____

Subject c. ______________________________

Reasons for disliking subject ____________________

____

____

Assignment Sheet 1

10. If you have participated in any school activities, organizations, or clubs, which two have you liked best and why?

Organization a. ______________________________

Reasons for liking organization ______________________________

____

____

Organization b. ______________________________

Reasons for liking organization ______________________________

____

____

11. If you have participated in any school activities, organizations, or clubs, which two have you liked least and why?

Organization a. ______________________________

Reasons for disliking organization ______________________________

____

____

Organization b. ______________________________

Reasons for disliking organization ______________________________

____

____

____

____

____

____

____

____

____

____

Assignment Sheet 1

12. What two activities do you most like to do in your spare time?

Activity a. ______________________________

Activity b. ______________________________

13. What two chores or tasks at home, on the job, or in volunteer work do you really enjoy?

Chore/task a. ______________________________

Chore/task b. ______________________________

14. What three things have you liked most about school?

a. ______________________________

b. ______________________________

c. ______________________________

15. What three things have you liked least about school?

a. ______________________________

b. ______________________________

c. ______________________________

Section B: Aptitudes Inventory

1. In which three school subjects do you do your best work or receive your best grades?

Subject a. ______________________________

Subject b. ______________________________

Subject c. ______________________________

2. In which three school subjects do you do you have the most difficulty or receive your poorest grades?

Subject a. ______________________________

Subject b. ______________________________

Subject c. ______________________________

3. Can you write clearly and correctly?

Yes ________ No ________

Assignment Sheet 1

4. Can you add, subtract, multiply, and divide?

   Yes _______ No _______

5. Can you work with fractions and percentages?

   Yes _______ No _______

6. Are you comfortable when talking with adults?

   Yes _______ No _______

7. Are you able to give a speech?

   Yes _______ No _______

8. Do you read well and understand what you have read?

   Yes _______ No _______

9. Do you get along well with people?

   Yes _______ No _______

10. Do you have musical or artistic talent?

    Yes _______ No _______

11. Are you good in athletics?

    Yes _______ No _______

12. Have you been a leader or held a responsible office in any organization?

    Yes _______ No _______

Section C: Skills Inventory

1. What business, office, or industrial machines can you operate?

   ____

   ____

   ____

   ____

Assignment Sheet 1

2. What special training in communication, social skills, or the fine arts have you received?

____

____

____

____

3. What special training have you received in subjects you have taken in school?

____

____

____

____

Section D: Values Inventory

The following are nine items many people value in their work. On the blanks beside the items, rank from 1 to 9, the things you want most from your work.

_______ High pay

_______ Security

_______ Independence

_______ Routine

_______ Variety

_______ Authority

_______ Creativity

_______ Respect

_______ Contribution to society

Assignment Sheet 1

Section E: Evaluation

1. Considering your answers to the interest inventory in Section A above, what are your three main interests?

   Interest a. ______________________________

   Interest b. ______________________________

   Interest c. ______________________________

2. Considering your answers to the aptitude and skills inventories in Sections B and C above, what three things do you do well?

   a. ______________________________

   b. ______________________________

   c. ______________________________

3. Reviewing your ranking of the values inventory in Section D above, list the three things you value most from work?

   a. ______________________________

   b. ______________________________

   c. ______________________________

4. Share the information you have recorded in this exercise with your guidance counselor, technology-education teacher, parents, or any one else you trust. On the blanks below, list any aptitudes, interests, skills, or values you discover as a result of this conversation.

   a. ______________________________

   b. ______________________________

   c. ______________________________

Introduction and self-inventory adpated from *Getting the Job* by Richard L. Lynch, Gregg Division, McGraw-Hill Book Company, copyright 1977.

Career-Exploration Process
Unit 5

Assignment Sheet 2—Gather General Job Information and Identify Occupational Area of Choice

Name ______________________ Date ____________

Evaluation criteria	**Rating**
Directions have been followed.	______
Content is relevant and well organized.	______
Overall rating	______

Evaluator's comments ______________________________

Introduction

You are enrolled in a course of study that can introduce you to interesting, rewarding, though often demanding, careers that are full of opportunities for qualified people and offer jobs that involve a wide variety of skills and various working conditions.

In this assignment sheet, you will get a sample of the different occupational areas and be given an opportunity to start thinking about the type of work you might want to do within an occupational area. Then, you will be able to start looking for an occupation that matches what you learned about your interests, aptitudes, skills, and values in Assignment Sheet 1.

Careers can be classified into categories called occupational areas. An *occupational area* is "a large group or cluster of jobs similar according to the nature of the work being performed."

Read the following sections of this introduction. These sections will give you an overview of the types of activities performed in the occupational areas. As you read these sections, make notes on the fields of work that seem to match the interests, aptitudes, skills, and values you learned about yourself in Assignment Sheet 1.

Occupational areas

The following is a list of the occupational areas that you will explore in technology education.

Communication. Jobs in the area of communication are involved with changing information into messages that can be exchanged between individuals or machines through a common system of signs, symbols, or behaviors.

Assignment Sheet 2

The workers in this occupational area include people who set up, operate, and maintain equipment such as the electronic equipment used to record and transmit radio and television programs as well as those who maintain and operate electronic-transmitting equipment such as telephone, telegraph, and satellite systems, and those who write, edit, store, and revise correspondence, reports, statistical tables, forms, books, magazine articles, and instructional materials.

See the communication section in Student Supplement 1 (page 197) for a sampling of only six of the many careers in the communication area.

Construction. Jobs in the area of construction are involved with processing manufactured goods and materials to be used in building a structure on site.

The workers in this occupational area include those in residential or light construction, who are mainly concerned with the building of homes, apartments, condominiums, and small commercial buildings; those in commercial construction, who are primarily concerned with the building of commercial, industrial, educational, and institutional buildings; and those in civil or heavy construction, who are primarily concerned with building highways, railroads, pipelines, utilities, water and sewer systems, dams, bridges, and electrical utilities.

See the construction section in Student Supplement 1 (page 211) for a sampling of only five of the many careers in the construction area.

Manufacturing. Jobs in the area of manufacturing are involved with processing materials to produce a product that will be used elsewhere.

The workers in this occupational area include those in production (supervisors, machinists, welders, assembly workers, industrial engineers, chemical engineers), research and development (design engineers, laboratory technicians), industrial relations (public-relations specialists, personnel directors, training directors), marketing (advertising managers, graphic designers, sales managers, salespersonnel), and financial affairs (comptrollers, accountants).

See the manufacturing section in Student Supplement 1 (page 223) for a sampling of only five of the many careers in the manufacturing area.

Energy, power, and transportation. Jobs in the area of energy, power, and transportation are involved with the processes in which energy is converted into mechanical, fluid, or electrical power to do work.

The workers in this occupational area include engineers, geologists, chemists, air-traffic controllers, dispatchers, pilots, railroad engineers, flight engineers, truck drivers, environmental-control specialists, and literally hundreds of other workers in various occupations.

See the energy, power, and transportation section in Student Supplement 1 (page 235) for a sampling of only five of the many careers in the energy, power, and transportation area.

Assignment Sheet 2

Exercise **Determine occupational area of choice**

Directions Your goal in this exercise is to get enough general job information so that you can determine the occupational area you wish to explore—Steps 2 and 3 in the career decision-making process. To do so, review the notes you have taken on the occupational areas discussed in the introduction to this assignment sheet. Then, compare these notes to the personal information you gathered in Assignment Sheet 1. Discuss your notes and personal inventory with someone whose opinion you respect, and then complete the following exercise.

1. From what you know about the occupational areas and from what you have learned about yourself, the occupational area in which you are most interested is? (Rank interest on a scale from 1 to 4.)

   _______ Communication

   _______ Construction

   _______ Manufacturing

   _______ Energy, power, and transportation

2. My occupational area of choice is ______________________________

   ____

Career-Exploration Process
Unit 5

Student Supplement 1—Career Search Booklet

ITE-197

Student Supplement 1

Sampling of the Careers in Communication

STUDENT SUPPLEMENT 1

Student Supplement 1

GRAPHIC DESIGNER

NATURE OF THE OCCUPATION

Visual artists use many different methods and materials to communicate ideas, thoughts and feelings. They generally fall into two different categories, graphic and fine artists.

Graphic artists produce art for commercial services such as major corporations, retail stores and advertising, design and publishing firms.

Fine artists produce art they display in museums, in galleries and homes.

Duties may include but are not limited to the following:

Fine Artists
- Expressing feelings in art
- Specializing in one or two media
- Selling works to stores, galleries, museums or collectors
- Doing other work to support their careers in art

Graphic Artists
- Serving clients' needs with art in advertising, design, packaging, illustration or cartoons

Free-lance Graphic Artists
- Recruiting potential clients and providing them with artistic service

OCCUPATIONAL SPECIALTIES

Cartoonists (141.061-010) draw political cartoons, newspaper comics or comic books.

Fashion Artists (141.061-014) draw stylish illustrations of new clothing fashions for newspaper or related advertisements.

Illustrators (141.061-022) create pictures for books, magazines, billboards, posters and record albums.

Medical and Scientific Illustrators (141.061-026) draw precise illustrations of machines, plants, animals or parts of the human body or animal bodies for business and educational purposes.

Set Illustrators (141.061-030) build and decorate sets for movies, television and theatrical productions.

Motion Picture Cartoonists (141.081-010) draw series of pictures for animated films shown on TV and in movies.

WORKING CONDITIONS

Graphic and fine artists generally work in art studios, at home or in offices. Graphic artists work 40-hour weeks but frequently work overtime to meet deadlines. Many graphic artists also free-lance for occasional clients. Independent visual artists often spend considerable time and effort recruiting potential clients. Some fine artists spend time working outdoors.

Tools, equipment and materials used may include:
- Airbrushes
- Acids
- Oil paints
- Watercolors
- Acrylics
- Clays
- Plasters
- Brushes and matte knives
- Canvas and gesso
- Pen and ink
- Wood
- Stone
- Plastic
- Sponges and rags
- Models and still-life arrangements
- Power and hand chisels
- Computers
- Knives
- Chalk
- Charcoal
- Pastels
- Varnish
- Turpentine and paint thinner
- Pencils
- Paper, cardboard and board
- Armatures
- Concrete
- Metal
- Wire
- Stone

You should like:
- Expressing emotions
- Working alone and with others
- Translating ideas into visual form
- Satisfying others' expectations

You should be able to:
- Analyze and visualize an artistic task into details
- Communicate well with clients and co-workers
- Use various media
- Work until a project is perfect
- Work against deadlines

Physically you must:
- See well, either naturally or with correction
- Have the stamina and health to work for extended periods of time

Special Requirements:

Good preparation for a visual arts career is usually a 4-year post-secondary art school program. This is absolutely essential for scientific and medical illustrators. To demonstrate and exhibit the skills gained, the art works produced in art school should be collected in a portfolio, including samples of the artist's best work. Before a candidate gains entry into the graphic art field or other art employment, the portfolio will be carefully examined by prospective employers.

GRAPHIC DESIGNER

Opportunities for Experience:

Many visual artists free-lance part-time while in art school, so that they gain both experience and a professional portfolio. Entry-level jobs in advertising and publishing require routine mechanical or paste-up work, but gradually artists are given more responsibility if they show promise.

Methods for Entry:

Visual artists apply directly to employers such as retailers, advertising and graphic design agencies, book publishers, newspapers, government, manufacturers and the motion picture industry. Positions may also be found through newspaper ads, school placement offices and local employment offices.

Earnings:

Employees with a Bachelor's degree in 1995 earned average starting salaries of $21,800. The average salary for visual artists with 1 year of experience was $18,980 per year. Because of the nature of this occupation, salaries fluctuate over a wide range. Self-employed visual artists range from part-timers to well-established graphic free-lance and fine artists. Part-timers must often accept low fees, while established artists can demand very high compensation. A graphic designer with 7 years' experience earns a national average of $24,700 per year.

Oklahoma Salary:

Region	Range
Central	8.00-11.00
Northeast	--
Northwest	--
Southwest	--
Southeast	--

Fringe Benefits:

Depending on the employer, visual artists on salary can receive paid vacations and holidays, life, accident and hospitalization insurance, retirement plans and sick pay. These benefits are paid, at least in part, by the employer. Self-employed artists, of course, must arrange for their own ways of meeting these costs.

Career ladder for this occupation may look like this:
- Partner/Own Business
- Partner
- Creative Director
- Art Director
- Assistant Art Director
- Mechanical Artists
- Free-lancer

Self-employed artists may advance as their work circulates and their reputation spreads. Some free-lancers remain free-lancers, chosen by publishers for specific kinds of illustration and free to choose the type of work they do.

EMPLOYMENT AND OUTLOOK

Visual artists held about 273,000 jobs in 1992. Visual art work is expected to grow as fast as average through the year 2005. Emphasis is increasing on visual appeal in packaging, marketing and other communication. Fine artists may find more demand from corporations as well as affluent individuals. Competition will continue to be keen.

Oklahoma Employment and Outlook

No data available.

Levels of education and training usually needed for this occupation:
- High school diploma or G.E.D.
- Technical, junior or community college

MORE SOURCES OF INFORMATION

- The Graphic Artists Guild
  11 West 20th Street, 8th Floor
  New York, NY 10011-3704
- American Institute of Graphic Arts
  1059 3rd Ave
  New York, NY 10021
- National Association of Schools of Art and Design
  11250 Roger Bacon Drive
  Suite 21
  Reston, VA 22090
- National Art Education Association
  1916 Association Drive
  Reston, VA 22091-1590

Student Supplement 1

PHOTOGRAPHER

NATURE OF THE OCCUPATION

Photographers use cameras and film to photograph or film people, places and events. They need a thorough understanding of camera operation, lighting, composition, darkroom procedures and the special characteristics of film and papers in order to visually record ideas and events.

Duties may include but are not limited to the following:
- Carefully arranging lighting and composition of the picture
- Using makeup, lights, reflectors, screens and props
- Mixing and developing chemicals
- Developing and printing film
- Enlarging, reducing and retouching prints

OCCUPATIONAL SPECIALTIES

Camera Operators (143.062-022) photograph various subjects and subject material, using motion picture, television broadcasting or video recording cameras and equipment.

Aerial Photographers (143.062-014) photograph segments of earth and other subject material from aircraft.

Scientific Photographers (143.062-026) photograph a variety of subject matter to illustrate and record scientific data or phenomena.

Still Photographers (143.062-030) photograph subjects, using still cameras, color or black-and-white film and a variety of accessories. They normally specialize in a particular area of photography, such as illustrative, fashion, architectural or portrait.

Photojournalists (143.062-034) use a still camera to photograph newsworthy events, locations, people or other illustrative and educational material for use in publications or telecasts.

Animation Camera Operators (143.382-010) operate special cameras to make animated cartoon motion picture films, by placing the background drawings on a horizontal easel over which the camera is suspended.

WORKING CONDITIONS

Photographers may work alone or with an assistant. Most work inside under pleasant conditions, while others work outside and are required to handle heavy and bulky equipment.

Salaried photographers who work in the government, commercial studios and advertising agencies generally work a standard 5-day, 40-hour week and receive time and half for overtime. Newspaper photographers and camera operators may work long and irregular hours and must be available on short notice. Free-lance photographers usually work longer hours, including evenings and weekends. Photojournalists may be called to cover an event whenever it occurs. Free-lance, news and commercial photographers travel frequently and may work in uncomfortable surroundings.

Photojournalists are usually members of The Newspaper Guild. Members usually pay dues.

Tools, equipment and materials used may include:
- Cameras
- Film
- Floodlights
- Reflectors
- Lenses and colored filters
- Electronic flash units
- Enlargers, automated printers
- Tripods

You should like:
- Communicating information to others
- Working with people
- Challenging situations

You should be able to:
- See detail and differences in shapes and shadings
- Work within precise limits or standards of accuracy
- Have a feeling for form and symmetry
- Use your imagination and be original in your thinking

Physically you must:
- Talk, hear and see well, either naturally or with correction,including color vision
- Have good manual dexterity and hand-eye coordination
- Reach for, handle and feel things

Opportunities for Experience:

Photography as a hobby, work on the school yearbook and the military services offer opportunities for experience in this field. Experience is also available through participation in a formal apprenticeship program.

Methods for Entry:

Methods of entering this occupation include direct application to employers and photographic supply houses and completion of an apprenticeship program. Positions may be located by consulting professional associations and unions, school and college placement offices, newspaper want ads and employment offices.

EARNINGS AND ADVANCEMENT

Earnings are affected by locations and assignments. Although self-employed and free-lance photographers earn more than salaried workers, their

PHOTOGRAPHER

earnings are affected greatly by business conditions and their community.

Earnings:

In 1995, the average photographer's yearly wage was about $28,800 after 3 years of experience. First-year photographers can expect to earn an average of $25,100 while those with 6 or more years of experience can earn an average of $32,662 annually.

Some self-employed photographers earn more than salaried workers, but many do not. Their earnings are affected by the number of hours worked, their skills, their marketing ability and general business conditions.

Oklahoma Salary:

Region	Range
Central	7.25-13.00
Northeast	9.00-13.00
Northwest	5.00-11.00
Southwest	--
Southeast	--

Fringe Benefits:

Depending on the employer, photographers may receive paid vacations and holidays, life, accident, disability and hospitalization insurance, retirement plans and sick pay. These benefits are usually paid, at least in part, by employers. Free-lance photographers and self-employed studio photographers must provide their own fringe benefits.

Career ladder for this occupation may look like this:

- Own Business
- Photographer
- Trainee/Apprenticeship

Most employers strongly prefer hiring individuals with two or more years of college training and courses in photography.

EMPLOYMENT AND OUTLOOK

There were approximately 118,000 photographers and camera operators employed nationally in 1992. Employment is expected to grow as fast as average through the year 2005. Scientific and medical research photography will offer excellent employment opportunities.

As the entertainment industry expands, jobs for movie and video camera operators should also grow, but competition will remain intense for such jobs. Employment in photojournalism is expected to grow slowly. Employment of camera operators is expected to grow rapidly as businesses make greater use of videos for training films, business meetings, sales campaigns and public relations work.

Photography is a competitive field, and only those with the most skill and the best business ability will be able to find salaried positions or attract enough work to support themselves as self-employed photographers.

Oklahoma Employment and Outlook

In Oklahoma, photographers are projected to have 17 job openings annually until the year 2000. All of these job openings represent replacements caused by leaving the occupation, promotions, retirements, etc. rather than new growth. In 1990, photographers held 1,190 jobs in Oklahoma. They are expected to hold 1,114 jobs by the year 2000. This is a decline in the growth rate.

Levels of education and training usually needed for this occupation:

- Less than high school diploma
- On-the-job training
- Technical, junior or community college
- Apprenticeship

Levels of education and training also available for this occupation:

- College - bachelor's degree

School subjects helpful in preparing for this occupation:

- Art
- Math
- Photography
- Chemistry

MORE SOURCES OF INFORMATION

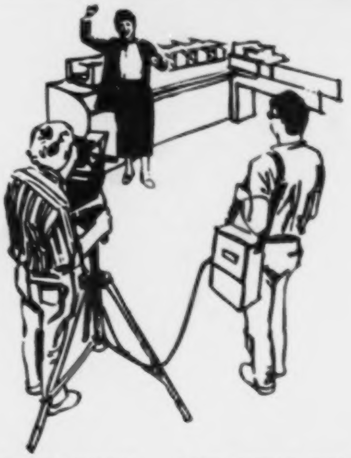
- American Society of Magazine Photographers
  419 Park Ave. South
  Suite 1407
  New York, NY 10016

- Newspaper Guild
  The Research and Information Department
  8611 Second Ave.
  Silver Spring, MD 20910

- American Society of Photographers
  P.O. Box 3191
  Spartanburg, SC 29304

- Professional Photographers of America
  57 Forsythe St, Suite 1600
  Des Plains, IL 60018

CAMERA OPERATOR



NATURE OF THE OCCUPATION

Camera operators work for local, network, and cable television stations. They cover news events as part of a reporting team. They also may capture and transmit live pictures to the television audience.

Camera operators employed in the entertainment field use motion picture cameras to film movies or electronically record movies, television programs and commericals. Some camera operators specialize in filming cartoons or other optical effects for television and movies.

Duties may include but are not limited to the following:
- Operating various sizes and types of cameras
- Placing cameras at varying angles
- Overseeing the handling and operation of cameras to be used
- Making sure that a scene through the camera lens appears the way the director of photography intends it to appear
- Evaluating the location to see what type of equipment is necessary
- Working with the director, sound mixer and lighting director to make sure everyone has the same idea for a shoot

WORKING CONDITIONS

Working conditions vary considerably. Camera operators may work both indoors and outside on movie and video sets, may frequently travel locally or overnight, and some travel to distant places for long periods of time. They may work long hours in a cramped and smelly darkroom or stand and walk for long periods while carrying heavy equipment.

Tools, equipment and materials used may include:
- Camera films and lenses
- Camera maintenance and travel equipment
- Varying types and sizes of cameras

You should like:
- Taking pictures
- Working in varied locations and weather conditions
- Working with detail
- Using your imagination to create different optical effects

You should be able to:
- Detect slight and detailed differences in objects
- Detect differing shades of color
- Note differing effects of lighting and know of ways to achieve those effects
- Work alone and with others
- Understand the workings of lenses, films, and light sources

Physically you must:
- Have good vision
- Handle, reach, and feel the camera and its parts
- Carry varying sizes and weights of cameras
- Have good manual dexterity

Opportunities for Experience:

Many employers prefer applicants with both training and experience in cinematography. Internships are great ways to gain experience in this field. Some schools offer internship programs for those studying in this area. Another way to gain experience is to work for a television station or privately by videotaping entertainers. Membership in a union also may prove to be helpful in securing employment.

Methods for Entry:

Internships with television stations may lead to full-time positions. This can also lead to greater job opportunities because of the experience you will have. Other employers may be film and video production companies, colleges and universities, and private companies which produce their own videotapes and film. Some persons trained in this field chose to be self-employed.

EARNINGS AND ADVANCEMENT

The salary of camera operators depends largely on the duration of the job, their experience, their education, union affiliation, and the type of work done on the project.

Earnings:

The median annual income for camera operators in 1995 was $23,100 per year. The middle 50 percent earned between $18,000 and $38,800. The top 10 percent earned more than $53,600, while the lowest 10 percent earned less

CAMERA OPERATOR

than $13,420. Earnings are affected by the number of hours worked, skills, marketing ability and general business conditions.

Oklahoma Salary:

Region	Range
Central	6.50-8.00
Northeast	--
Northwest	--
Southwest	--
Southeast	--

Career ladder for this occupation may look like this:

- Director of Photography
- Camera Operator
- Camera Assistant

Camera operators may advance to teaching positions or be employed as photography directors for movies or television.

EMPLOYMENT AND OUTLOOK

Employment of camera operators is expected to grow about as fast as the average for all occupations through the year 2005, with business making greater use of videos for training films, business meetings, sales campaigns, and public relations work. Expansion of the entertainment industry will create additional openings, but competition will be keen for what generally is regarded as an exciting field. Larger cities boast an increased chance of employment as a camera operator.

Oklahoma Employment and Outlook

In Oklahoma, 3 job openings are projected annually for camera operators until the year 2000. These job openings represent new jobs and vacancies caused by leaving the occupation, promotions, retirements, etc. In 1990, camera operators held 96 jobs in Oklahoma. They are expected to hold 106 jobs by the year 2000. This is considered a slow growth rate.

Levels of education and training usually needed for this occupation:

- On-the-job training
- Junior/technical/community college
- Bachelor's degree

School subjects helpful in preparing for this occupation:

- Arts
- Graphic arts
- Journalism
- Photography
- Theatre and drama

MORE SOURCES OF INFORMATION

- American Society of Media Photographers
  Suite 502-14
  Washington Road
  Princeton Junction, NJ 08550

RADIO OPERATOR

NATURE OF THE OCCUPATION

Radio operators send and receive messages following procedures prescribed by federal regulations.

Duties may include but are not limited to the following:
- Turning on power control switches for transmitting and receiving equipment
- Turning dials to set frequency and other controls
- Monitoring the control panel to make sure that components are working correctly
- Maintaining communication systems by making routine tests
- Keeping logs of transmissions and records of testing results

OCCUPATIONAL SPECIALTIES

There are several areas of specialization within this occupation.

Dispatchers (193.262-074) operate radio and telephone equipment to receive reports and requests from firefighting crews, fire-lookout stations and mobile units, and relay information or orders to officials concerned with the matter.

Radio Officers (193.262-022) operate and maintain the radiotelegraph and radiotelephone equipment and accessories aboard ships. They also monitor emergency frequencies for ship and distress calls.

Transmitter Operators (193.262-038) test, monitor, control and repair radio transmitters for broadcast radio and television programs.

Radiotelegraph Operators (192.262-030) control and maintain equipment used in radiotelegraph communications, relaying messages to addressees by telephone or teletype. They also call ships or stations by code, and monitor emergency distress calls.

Radiotelephone Operators (192.262-034) control and repair radiotelephone transmitting and receiving equipment used for commercial communications.

Photoradio Operators (193.362-010) send and receive radio photographs. They develop negatives, print photographs, and repair equipment as needed.

WORKING CONDITIONS

Radio operators may work alone or in teams with other operators, communications technicians, engineers, ships' captains, pilots, navigators or police and emergency personnel.

Generally, radio operators work a 40-hour week. In order to meet deadlines or during emergencies, they may be required to work overtime. In many establishments, 24-hour radio operation is required. Consequently, radio operators may work assigned hours on day, afternoon, midnight, or swing shifts, and may sometimes be on call at all hours. Shift assignments may include weekends and holiday work.

Radio operators may join one or more professional associations or unions such as the National Association of Broadcasters. Members pay periodic dues.

Tools, equipment and materials used may include:
- Communications equipment
- Diagrams and charts
- Electronic testing and monitoring systems
- Hand tools
- Radar and other navigational equipment
- Radio transmitters and receivers
- Recording and TV equipment
- Reference and instructional manuals
- Schedules and log books
- Transformers and batteries

You should like:
- Doing scientific and technical work
- Working with equipment and machinery

You should be able to:
- Interpret written and spoken instructions
- Follow exact standards and regulations
- Perform a variety of duties
- Stay alert for long periods of time
- Work well under pressure
- Learn codes, symbols, and technical language

Physically you must:
- See and hear well, either naturally or with correction
- Speak rapidly, clearly and distinctly
- Use your hands skillfully

Special Requirements:

Most radio operators must be licensed by the Federal Communications Commission (FCC). To obtain a license, an applicant must pass a series of examinations given by the FCC. Licensing requirements are usually governed by the type of transmission involved and whether an operator's duties include making adjustments to transmitters. To obtain a first-class radiotelegraph operator's permit, one must be 21 and have at least 1 year of experience. Radio officers who work on ships must be licensed by both the FCC and the U. S. Coast Guard.

RADIO OPERATOR

Military installations require security clearance for radio operators.

Opportunities for Experience:
Learning Morse code, participating in radio hobby groups, and building and operating an amateur radio station provide experience. Part-time or summer work in communications or electronics may be helpful. All branches of the military services offer experience.

Methods for Entry:
The most common method of entry is through direct application to employers. Schools, professional associations and unions may provide information on job opportunities.

EARNINGS AND ADVANCEMENT

Earnings of radio operators vary according to the individual's education and experience, employer, geographic location and job specialty. The type of FCC license held will also affect earnings.

Earnings:
In 1995, radio operators earned a national average of $39,383 per year after 5 years; beginning operators averaged $32,390. Higher rates were paid to those in large metropolitan areas.

Fringe Benefits:
Fringe benefits may include health, life, and disability insurance, paid vacations and holidays, sick leave and retirement plans. These benefits may be paid, at least in part, by employers.

Career ladder for this occupation may look like this:
- Supervisor Radio Operator
- Radio Operator

Another career ladder may look like this:
- Radio Chief
- Chief Airline-Radio Operator
- Airline-Radio Operator

Advancement of radio operators may be determined by experience, the FCC license held, job performance, and education.

EMPLOYMENT AND OUTLOOK

There are approximately 16,000 radio operators employed nationally. Employment of radio operators is expected to grow as fast as the average for all occupations through 2005.

Oklahoma Employment and Outlook

In Oklahoma, radio operators are projected to have 1 job opening annually until the year 2000. This job opening represents replacements caused by leaving the occupation, promotions, retirements, etc. rather than new job growth. In 1990, radio operators held 40 jobs in Oklahoma. They are expected to hold 41 jobs by the year 2000. This is considered a slow growth rate.

Levels of education and training usually needed for this occupation:
- On-the-job training
- Technical, junior or community college

School subjects helpful in preparing for this occupation:
- Electricity and electronics
- Speech
- Typing

MORE SOURCES OF INFORMATION

- National Association of Broadcasters
  Career Publications Dept.
  1771 N Street NW
  Washington, DC 20036-2891

- National Association of Broadcast Employees and Technicians
  7101 Wisconsin Avenue
  Suite 800
  Bethesda, MD 20814

Student Supplement 1

WORD PROCESSOR

NATURE OF THE OCCUPATION

Word processors use the automated or electric keyboards or consoles of word-processing machines to record, edit, store and revise correspondence, reports, statistical tables, forms and other materials. Word-processing machines consist of a keyboard, a video-display terminal and a printer.

Duties may include but are not limited to the following:

- Positioning and loading the console with blank tapes or disks
- Inserting paper into the typewriter carriage
- Setting controls for margins, spacing and tabulation
- Typing from the typed or handwritten draft or from machine dictation
- Reading copy for errors
- Searching for a specific set of stored, typed characters in order to make changes
- Retyping and adding or deleting letters, words or lines to correct errors
- Filing tapes, cards, disks, correspondence and reports

OCCUPATIONAL SPECIALTIES

Word-Processing Machine Operators (203.382-030) operate word processing machine equipment to compile, type, revise, combine, edit, print and store documents.

Photocomposition-Keyboard Operators (203.582-046) operate keyboards of computer terminals equipped with video display screen to record data from manuscript for storage and retrieval into and from computer system for subsequent reproduction as printed matter.

Transcribing-Machine Operators (203.582-058) operate typewriters to transcribe letters, reports or other recorded data through earphones of transcribing (voice-reproducing) machines.

WORKING CONDITIONS

Beginning word processors generally work under the supervision of a more experienced worker or a clerical supervisor. Some may work under the direction of the office supervisor.

Word processors usually work in clean, well-lighted, well-ventilated offices. Offices may be noisy from office machines or people talking. Word processors must be able to sit for long periods of time.

Most word processors work a 5-day, 35- to 40-hour week. Overtime may occasionally be necessary to complete a project or meet a deadline. Many word processors hold temporary jobs and 1 in 4 work part-time. Some are self-employed freelance word processors; others are employed by temporary help agencies.

Tools, equipment and materials used may include:

- Word processing machines
- Magnetic tapes, cards or floppy or hard disks
- Files and paper
- Forms
- Print wheels or typing elements
- Ribbon cartridges
- Tape erasers
- Machine dictation/transcription unit
- Teleprocessing terminals

You should like:

- Activities of a routine, definite, organized nature
- Activities involving machines, processes or methods
- Activities concerned with the communication of information

You should be able to:

- See detail in objects or drawings and recognize slight differences in shapes or shadings
- See details and recognize errors in numbers, spelling and punctuation in written materials, charts or tables
- Determine correct grammar, punctuation and spelling for information received orally
- Repeat tasks of short duration according to a set procedure
- Work within precise standards of accuracy
- Make decisions based on verifiable data, using standards that can be checked or measured

Physically you must:

- Sit for long periods
- Reach for, handle, finger and feel objects
- Coordinate the movement of eyes and hands or fingers
- See well, either naturally or with correction

Student Supplement 1

WORD PROCESSOR

Opportunities for Experience:

Although few ways to explore or gain experience exist except through training, summer or part-time clerical jobs may offer a chance to sharpen skills and observe the duties of a word processor. Secondary vocational education programs in the business and office cluster and post-secondary education programs in word processing may offer practical experience through a co-op portion.

Methods for Entry:

High school and business school placement services help interested persons find employment in this occupation. Applicants should apply at business personnel offices and look at classified ads in newspapers. Assistance in locating jobs may also be obtained from local offices of state employment offices. Persons interested in obtaining employment with government agencies should apply at federal, state or local civil service offices.

EARNINGS AND ADVANCEMENT

Earnings of word processors vary according to their experience, level of responsibility, employer and geographic location.

Earnings:

Word processors earned an average salary of $20,360 in 1995; beginners earning approximately $16,281 per year. Salaries vary by industry. They tend to be highest in transportation and public utilities and lowest in retail trade and finance, insurance and real estate. Similarly, their salaries tend to vary by region of the country, with salaries in the West being the highest.

Oklahoma Salary:

Region	Range
Central	5.75-9.00
Northeast	--
Northwest	5.75-9.00
Southwest	5.75-9.00
Southeast	5.00-7.25

Fringe Benefits:

Depending on the employer, most word processors receive paid vacations and holidays, life, accident, disability and hospitalization insurance, retirement plans and sick pay. Some employers may offer savings and stock investment plans. These benefits are usually paid, at least in part, by the employer.

Career ladder for this occupation may look like this:

- Word Processing Supervisor
- Word Processor
- Trainee

Advancement usually comes after additional education or training or with experience and seniority and can take several forms. Many word processors consider higher pay a form of advancement. Word processors may also advance to other jobs that involve originating, proof-reading and editing documents; establishing and coordinating priorities within a unit; supervising other word processors or providing management direction for word processing and administrative services.

EMPLOYMENT AND OUTLOOK

In 1992, there were 1,238,000 typists, including word processors and data entry keyers, employed in all sectors of the economy. Four of every ten worked for educational institutions, hospitals, law offices and business service firms. About 20 percent worked for federal, state and local governments.

A decline in employment is expected for typists, data entry keyers and word processors through the year 2005. There will continue to be substantial openings because of the many word processors who retire or transfer to other occupations.

The best job prospects will be for those word processors with the best technical skills. Knowing many word processing programs, particularly the more complex ones, will qualify a word processor for more jobs.

Oklahoma Employment and Outlook

No data available.

Levels of education and training usually needed for this occupation:

- High school diploma or G.E.D.

School subjects helpful in preparing for this occupation:

- College preparatory
- Business English
- Office machines
- Typing
- Business data processing
- Business law
- Office practice

MORE SOURCES OF INFORMATION

- National Association of Professional Word Processing Technicians
  P.O. Box 1444
  Philadelphia, PA 19105

- National Business Education Association
  1914 Association Drive
  Reston, VA 22091

- Professional Secretaries International
  10502 NW Ambassador Drive
  Kansas City, MO 64195-0404

WRITER AND EDITOR

NATURE OF THE OCCUPATION

Writers develop fiction and nonfiction prose for books, magazines, newspapers, radio and television, brochures and advertisements.

Duties may include but are not limited to the following:

- Selecting a topic or being assigned one
- Researching the topic through library study, interviews, and observation
- Selecting and organizing information and writing to achieve a desired effect
- Revising or rewriting for the best organization or the right phrasing

OCCUPATIONAL SPECIALTIES

Critics (131.067-018) write critical reviews of literary, musical or artistic works or performances for broadcast or publication.

Fiction and Nonfiction Prose Writers (131.067-046) write original prose material for publication.

Screen Writers (131.067-050) write scripts for motion pictures or television.

News Writers (131.267-014) write news items for newspapers, magazines or news broadcasts.

Technical Publications Writers (131.267-026) write about scientific and technical information in clear language.

Publications Editors (132.037-022) plan the contents and budget of publications and supervise their preparation.

Assignment Editors (132.137-010) work under an executive editor; they assign writers on particular subjects.

WORKING CONDITIONS

Some writers work in private offices; others work in crowded, noisy rooms filled with other writers and typewriters. Some writers travel to various sites; others spend more time in libraries and on the telephone. Writers usually work 35 to 40 hours a week. Nights and weekends are required of those who write for morning or weekend publications or broadcasts.

Tools, equipment and materials used may include:

- Typewriters
- Computers
- Electronic calculators
- Tape recorders

You should like:

- Working with words
- Working with a variety of people
- Working with information that requires thought and analysis
- Expressing yourself clearly and imaginatively
- Researching new information

You should be able to:

- Work alone
- Analyze material and sort out details
- Communicate well with clients and co-workers
- Use office machines, especially computers
- Work efficiently under deadline pressure

Physically you must:

- Sit at a desk for long periods
- See well, either naturally or with correction

Special Requirements:

A college degree is generally required; majors especially preferred are communications and journalism. A liberal arts background is desired by some employers. Jobs in technical writing require a degree in or knowledge of such fields as a science, engineering or business. Acquaintance with word processing, electronic publishing and video production equipment for writing and editing is very useful. Practical experience is expected in newspapers, literary magazines or radio stations.

Opportunities for Experience:

Summer internships may be available for students. Interns may run errands, answer phones, do research and interviews and write short articles or advertisements.

Methods for Entry:

Direct application to employers and taking civil service exams are realistic approaches. Some positions are also announced in newspaper want ads, school placement offices and local employment offices.

EARNINGS AND ADVANCEMENT

Writers and editors can advance within an organization or advance by moving to another firm. Larger firms usually give writing and editing responsibilities only after a period of entry-level research, fact-checking and proofreading. Smaller firms give major duties right away, and competence is expected.

Earnings:

Beginning writers earned around $14,951 as a starting salary in 1995. Experienced writers had salaries averaging over $20,000 per year. Technical writers and editors who worked for the federal government were paid higher averages than those offered in the private sector.

Average annual salaries for first-time editors was $27,540 per year. With 12 or more years of experience, this salary range went to an average of $39,082. Once

WRITER AND EDITOR

again, the averages for those employed by the government were slightly higher.

Oklahoma Salary:

Region	Range
Central	8.00-15.50
Northeast	8.00-17.00
Northwest	10.00-17.00
Southwest	9.00-11.00
Southeast	--

Fringe Benefits:

Depending on the employer, writers and editors may receive paid vacations and holidays, life, accident, disability and hospitalization insurance, retirement plans and sick pay. These benefits are usually paid, at least in part, by the employer. In addition, many writers and editors free-lance to supplement their salaries.

Career ladder for this occupation may look like this:
- Partner/Owner
- Executive Editor/Creative Director
- Associate Editor/Copy Supervisor
- Assistant Editor/Senior Copy Writer
- News Writer/Copy Writer
- Editorial Assistant/Production Assistant

EMPLOYMENT AND OUTLOOK

Writers and editors held about 283,000 jobs in 1992. Their employment is expected to rise as fast as the average for all occupations through the year 2005. Publishers of books, magazines and newspapers and nonprofit organizations—including government, business, professional, civic and religious associations—are expected to increase their staffs. Advertising, public relations and technical writing are likely to need fresh talent, as are the broadcasting and entertainment industries. Competition for openings will remain keen, despite high turnover. Business, trade and technical writing will provide the best opportunities.

Oklahoma Employment and Outlook

In Oklahoma, writers and editors are projected to have 46 job openings annually until the year 2000. These job openings represent new job growth and replacements caused by leaving the occupation, promotions, retirements, etc. In 1990, writers and editors held 1,538 jobs in Oklahoma. They are expected to hold 1,754 jobs by the year 2000. This is considered an average growth rate.

Levels of education and training usually needed for this occupation:
- College - bachelor's degree

Levels of education and training also available for this occupation:
- College - master's degree

School subjects helpful in preparing for this occupation:
- College preparatory
- Journalism
- English
- Typing

MORE SOURCES OF INFORMATION

- The Dow Jones Newspaper Fund
  P.O. Box 300
  Princeton, NJ 08543-0300

- American Society of Magazine Editors
  Marlene Kahan, Executive Director
  919 3rd Avenue, 22nd Floor
  New York, NY 10022

- Women in Communications, Inc.
  3717 Columbia Pike, Suite 310
  Arlington, VA 22204

- Society for Technical Communication, Inc.
  901 N. Stuart St., Suite 904
  Arlington, VA 22203-1854

- Accrediting Council on Education in Journalism and Mass Communications
  U of KS-School of Journalism
  Stauffer-Flint Hall
  Lawrence, KS 66045

Student Supplement 1

Sampling of the Careers in Construction

STUDENT SUPPLEMENT 1

Student Supplement 1

ARCHITECT

NATURE OF THE OCCUPATION

Architects plan, design and supervise the construction of all types of buildings, such as private homes, offices, theaters, libraries, museums and factories. Architects are involved in each phase of the project's development and must have a wide variety of skills, which include design, engineering, managerial and supervisory skills.

Duties may include but are not limited to the following:

- Referring to building codes and zoning laws
- Working with drafters to prepare drawings for the client
- Developing detailed drawings and models
- Presenting designs to the client for approval
- Translating the design into construction documents
- Selecting a builder or contractor
- Supervising the construction of the building

OCCUPATIONAL SPECIALTIES

Architects (001.061-010) may specialize in a particular area such as project manager, designer, drafter, specifications writer or cost estimator. Architects may also specialize in the design of certain types of buildings.

Marine Architects (001.061-014) design and oversee the construction and repair of marine craft and floating structures, such as ships, barges, submarines, torpedoes and buoys.

Landscape Architects (001.061-018) plan and design the development of land areas for projects, such as recreational facilities, airports, highways, hospitals, schools, golf courses and sites that are planned for residential, commercial and industrial development.

School-Plant Consultants (001.167-010) formulate and enforce the standards for the construction of public school facilities. They develop legislation relative to school building sites and school design and construction.

Architectural Drafters (001.261-010) prepare detailed drawings of architectural designs and plans for buildings, according to the specifications, sketches and rough drafts that are provided by architects.

Landscape Drafters (001.261-014) prepare detailed scale drawings and tracings from rough sketches or other data provided by a landscape architect.

WORKING CONDITIONS

Architects generally work in clean, well-lighted, and well-ventilated offices and many spend long hours at the drawing board. Most of their time is spent in offices advising clients, developing reports and drawings and working with other architects and engineers. They also spend a great deal of time at the construction site reviewing the progress of the project. Architects usually work 40 hours a week, and often travel to a client's office or to building sites.

They may have to furnish some or all of their drafting tools, as well as their own transportation.

Architects may belong to professional associations such as the American Institute of Architects and the Society of American Registered Architects. Members usually pay dues.

Tools, equipment and materials used may include:

- Drawing tools
- Parallels
- Scales
- Product handbooks
- Computers
- Cameras
- Model makers
- Drawing boards or tables
- Miscellaneous printed material
- Calculators

You should like:

- Working with others as a team member for a common goal
- Activities of a scientific or technical nature
- Activities that require creative imagination

You should be able to:

- Work both independently and as part of a team
- Perform a variety of duties that may change often
- Work within precise limits or standards of accuracy
- Visualize flat drawings or pictures as solid objects
- Perform arithmetical operations quickly and accurately
- Reason logically and present information effectively
- Plan, direct and control an entire activity or the activities of others
- Communicate ideas/directions effectively to others

Physically you must:

- Use your hands and fingers to draw and make models
- See well, either naturally or with correction

Special Requirements:

All states require passing a licensing exam before practicing architecture. Prerequisites for the exam include a bachelor's or master's of architecture from one of the 96 schools that have an accredited program in architecture certified by the National Architectural Accrediting Board (NAAB), a 3-year practical training/internship requirement (1

ARCHITECT

year of which must be employment in the office of a registered architect) and passing all sections of the Architect Registration Examination. Reciprocity agreements between states are among the best in all professions.

Opportunities for Experience:

Practical experience is part of the course of study in a school of architecture, although summer jobs in drafting or construction may be available and are certainly helpful.

EARNINGS AND ADVANCEMENT

Salaries vary according to the type of firm and its geographic location. Architects with well-established private practices generally earn more than highly paid salaried employees in architectural firms. Architects starting their own practices may go through a period when their expenses are greater than their income.

Earnings:

The average salary offer to college graduates with a bachelor's degree in architecture was $31,876 per year in 1995. Architects with 5 years of experience could expect to earn an average of $43,143 a year.

College graduates with a bachelor's degree in architectural design averaged an annual starting salary of $23,210 in 1995.

Fringe Benefits:

Depending on the employer, architects may receive paid vacations and holidays, life, accident and hospitalization insurance, retirement plans and sick pay. These benefits are usually paid, at least in part, by the employers.

Career ladder for this occupation may look like this:

- Principal or Senior Partner
- Partner
- Project Manager
- Architect
- Drafter

Architects may advance through experience, further training and education and handling complex assignments.

EMPLOYMENT AND OUTLOOK

There were approximately 96,000 architects employed nationally in 1992. Employment opportunities are expected to be good through the year 2005, and employment is expected to rise as fast as the average for all occupations. Employment is not expected to be affected by computer technology, but is affected by the cyclical changes in the economy. Competition will continue to be keen for jobs in the most prestigious firms which offer good potential for career advancement. The demand for architects is highly dependent upon the local level of construction, particularly of nonresidential structures.

Oklahoma Employment and Outlook

In Oklahoma, architects are projected to have 21 job openings annually until the year 2000. Most of these job openings represent replacements caused by leaving the occupation, promotions, retirements, etc. rather than new job growth. In 1990, architects held 1,010 jobs in Oklahoma. They are expected to hold 1,045 jobs by the year 2000. This is considered a slow growth rate due to the relatively large number of architects employed in Oklahoma in 1990.

Levels of education and training usually needed for this occupation:

- Technical, junior or community college
- College - bachelor's degree
- College - master's degree

School subjects helpful in preparing for this occupation:

- College preparatory
- English
- Geometry
- Physics
- Blueprint reading
- Graphic arts
- Mechanical drawing
- Arts
- Algebra
- Trigonometry
- History
- Drafting
- Industrial arts

MORE SOURCES OF INFORMATION

- Association of Collegiate Schools of Architecture
  1735 New York Avenue, NW
  Washington, DC 20006

- Director, Education Programs Department
  American Institute of Architects
  1735 New York Avenue, NW
  Washington, DC 20006

- JETS-Guidance
  1420 King Street, Suite 405
  Alexandria, VA 22314-2715

- Society of American Registered Architects
  1245 S. Highland Ave.
  Lombard, IL 60148

CIVIL ENGINEER

NATURE OF THE OCCUPATION

Today, the world is undergoing vast changes. The technological revolution, population growth and gripping enviromental concerns have created a demand for civil engineers of every specialty. Now, more than ever, the world needs people trained to meet the challenges of pollution, traffic congestion, drinking water and energy needs, urban redevelopment and community planning.

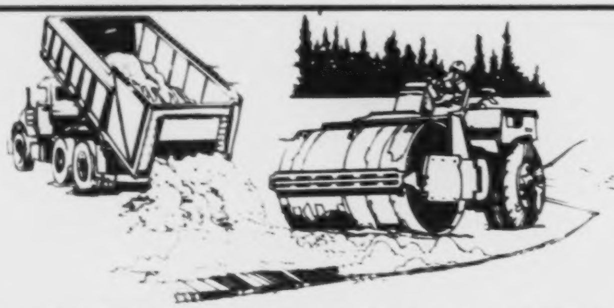
Civil engineers plan, design and supervise the construction and maintenance of structures and facilities such as roads, airports, tunnels, bridges, water supply and sewage systems and buildings. Civil engineers may perform technical research and use computers as aids in developing solutions to engineering problems.

Duties may include but are not limited to the following:

- Preparing plans and specifications
- Estimating costs and requirements of projects
- Testing materials to be used
- Determining solutions to problems
- Supervising construction and maintenance
- Inspecting existing or newly constructed projects, and recommending repairs
- Performing technical research
- Determining the impact of construction on the environment

OCCUPATIONAL SPECIALTIES

Transportation Engineers (005.061-038) design and prepare plans, estimates and specifications for the construction and operation of surface transportation projects. Transportation engineers may specialize in a particular phase of the work such as making surveys of roads, improving road signs or lighting, or directing and coordinating construction or maintenance activity.



Structural Engineers (005.061-034) plan, design and oversee the erection of steel and other structural materials in buildings, bridges and other structures that require a stress analysis.

Hydraulic Engineers (005.061-018) design and direct the construction of power and other hydraulic engineering projects for the control and use of water.

Sanitary Engineers (005.061-030) design and oversee the construction and operation of hygienic projects.

Environmental Engineers (005.061-014) apply a knowledge of engineering by correcting or improving various areas of environmental concern, such as air, soil or water pollution.

WORKING CONDITIONS

Civil engineers may work alone or with other engineers, surveyors or supervisors, from 35 to 55 hours a week. They may work at construction sites or in clean, well-lighted and well-ventilated offices and research and testing labs.

Civil engineers may also work in remote areas of foreign countries, often moving from place to place to work on different projects. Civil engineers may be required to furnish part of their drafting equipment.

Civil engineers may belong to an association such as the American Society of Civil Engineers. Members usually pay dues.

Tools, equipment and materials used may include:

- Blueprints and specifications
- Calculators
- Computers
- Drafting tools and equipment
- Handbooks
- Surveying equipment

You should like:

- Working with scientific and technical subjects
- Work requiring precise results
- Performing a variety of duties
- Problem solving

You should be able to:

- Supervise others
- Accept responsibility
- Perform mathematical operations quickly and accurately
- Perform detailed and accurate work
- Make judgments based on verifiable information
- Express yourself clearly, both verbally and in writing

Physically you must:

- See well, either naturally or with correction
- Have full use of arms, legs and hands

Special Requirements:

All 50 states and the District of Columbia have licensing regulations for engineers whose work affects life, health or property. Each state administers its own examination. All states now have legal provisions to grant engineering licensing by reciprocity.

BEST COPY AVAILABLE

CIVIL ENGINEER

Opportunities for Experience:

Part-time employment may be available as an engineering assistant after 1 or 2 years of college. Co-op programs in college and summer employment on construction sites provide experience.

Methods for Entry:

Methods of entering this occupation include direct application to employers and taking civil service exams. Positions may also be located by consulting local newspaper want ads, college placement offices and your local employment office.

EARNINGS AND ADVANCEMENT

Earnings depend upon the size of the employer, geographic location and employee's qualifications.

Earnings:

In 1995, the average salary offer to college graduates with a bachelor's degree in civil engineering was $30,348 per year according to the College Placement Council. Civil engineers with 1 year of experience averaged annual salaries of $30,101 while the average salary for those with 10 years of experience was $57,933 per year.

Civil engineers with a master's degree were offered first-year salaries averaging $34,744 while those with a Ph.D were offered $41,167.

Oklahoma Salary:

Region	Range
Central	17.00-23.00
Northeast	19.00-30.00
Northwest	--
Southwest	--
Southeast	--

Fringe Benefits:

Depending on the employer, civil engineers may receive paid vacations and holidays, paid sick leave, life, accident, disability and hospitalization insurance and retirement plans. These benefits are usually paid, at least in part, by the employer. Civil engineers may also receive educational reimbursements, a company car and an expense account.

Career ladder for this occupation may look like this:
- Researcher
- Supervisor
- Civil Engineer

Civil engineers may advance with experience or additional training or education.

EMPLOYMENT AND OUTLOOK

There were approximately 173,000 civil engineers employed nationally in 1992. Employment of civil engineers is expected to grow as fast as average for all occupations through the year 2005. A growing economy is expected to result in a growing demand for manufacturing plants, transportation systems, generating plants, off-shore drilling facilities and environmental pollution control.

Oklahoma Employment and Outlook

In Oklahoma, civil engineers are projected to have 50 job openings annually until the year 2000. These job openings represent new job growth and replacements caused by leaving the occupation, promotions, retirements, etc. In 1990, civil engineers held 1,355 jobs in Oklahoma. They are expected to hold 1,569 jobs by the year 2000. This is considered an average growth rate.

Levels of education and training usually needed for this occupation:
- Technical, junior or community college
- College - bachelor's degree
- College - master's degree

School subjects helpful in preparing for this occupation:
- College preparatory
- Algebra
- Computer science
- Trigonometry
- Chemistry
- Economics
- Drafting
- Composition
- Calculus
- Geometry
- Biology
- Physics
- Blueprint reading
- Mechanical drawing

MORE SOURCES OF INFORMATION

- Accreditation Board for Engineering and Technology
  345 East 47th Street
  New York, NY 10017

- American Society of Civil Engineers
  Student Services Department
  18th Floor
  345 East 47th Street
  New York, NY 10017

- JETS-Guidance
  1420 King St., Suite 405
  Alexandria, VA 22314-2794

Student Supplement 1

DRAFTER

NATURE OF THE OCCUPATION

Drafters prepare detailed drawings of buildings, products and machinery from sketches and specifications made by engineers, architects and designers. Many drafters now use computers to draw illustrations and do their work.

Duties may include but are not limited to the following:

- Preparing complete and accurate working plans and detailed drawings from rough or detailed sketches or notes
- Preparing final sketches and checking dimensions of parts and materials to be used
- Preparing charts of statistical data
- Drawing finished designs from sketches
- Reproducing working drawings on copy machines
- Using computer-aided drafting systems to prepare drawings.

OCCUPATIONAL SPECIALTIES

Architectural Drafters (001.261-010) produce architectural and structural working drawings of any type of building or other structure to comply with building codes.

Electrical Drafters (003.281-010) prepare wiring diagrams and drawings of electrical equipment for use by construction and repair workers who build, install and repair electrical equipment and wiring.

Civil Drafters (005.281-010) prepare detailed construction drawings, topographical profiles and related maps and specification sheets used in the planning and construction of highways, in flood control, drainage and other projects.

Mechanical Drafters (007.281-010) prepare detailed working drawings of machinery and mechanical devices.

Marine Drafters (014.281-010) make drawings of ships, docks and other marine structures and equipment.

Commercial Drafters (017.261-026) perform general duties in all-around drafting such as laying out building locations, planning arrangements and preparing charts, forms and records.

WORKING CONDITIONS

Drafters may work alone or as a member of a drafting team under the direction or supervision of a more experienced drafter, chief drafter, project drafter, engineer or architect.

Drafters either sit or stand at drafting tables in well-lighted rooms. They may sometimes work at construction sites or in machine shops.

Drafting work can be demanding and requires close attention to detail and many hours may be spent leaning over tables, or sitting at computer terminals, working on large drawings.

Drafters generally work a 5-day, 35- to 40-hour week. Overtime may be necessary to meet deadlines.

Drafters may join professional associations such as the American Institute for Design and Drafting. Members usually pay dues.

Tools, equipment and materials used may include:

- Drafting machines
- Calculators
- Rulers, templates
- T-squares
- Dividers
- Protractors
- Technical handbooks
- Precision measurement instruments
- Engineering tables and manuals
- Mechanical/computerized drafting tools
- Slide rules
- Straight edges
- Triangles
- Compasses
- French curves
- Computer-aided drafting (CAD) systems

You should like:

- Activities of a scientific or technical nature
- Working with things and objects
- Activities that involve machines, processes or methods

You should be able to:

- Work within precise limits or standards of accuracy

Student Supplement 1

DRAFTER

- Understand and apply technical knowledge and theoretical principles
- Perform mathematical computations accurately
- Rate information according to measurable standards
- Concentrate for long periods of time
- Work under pressure
- Draw freehand three-dimensional objects
- Do detailed work accurately and neatly

Physically you must:
- Use your arms, hands and fingers well
- See well, either naturally or with correction

Opportunities for Experience:
Summer and part-time and co-op programs may be available through high schools, vocational centers or community colleges. Experience can also be gained through a formal apprenticeship program or any branch of the military service.

Methods for Entry:
Methods of entering this occupation include direct application to employers and taking civil service exams. Positions may also be located by consulting newspaper want ads, school and college placement offices and local employment offices.

EARNINGS AND ADVANCEMENT

Earnings depend upon the type of company and geographic location. Earnings are higher for workers in urban areas and for those working for manufacturing companies.

Earnings:
Nationally, drafters working full-time earned an average annual salary between $20,741 and $28,021, depending on experience. Experienced drafters in manufacturing, transportation and utilities earned salaries averaging between $21,018 and $35,595 per year. Senior drafters averaged about $40,906 a year.

Oklahoma Salary:

Region	Range
Central	11.00-13.00
Northeast	10.00-15.50
Northwest	11.00-13.00
Southwest	9.00-15.50
Southeast	7.25-11.00

Fringe Benefits:
Depending on the employer, drafters may receive paid vacations and holidays; health, accident and dental insurance; retirement plans; and sick leave. These benefits are usually paid, at least in part, by the employer.

Career ladder for this occupation may look like this:
- Senior Drafter or Chief Drafter
- Junior Drafter
- Trainee/Apprentice

Drafters may advance through experience and additional education.

EMPLOYMENT AND OUTLOOK

There were approximately 314,000 drafters employed nationally in 1992. Employment of drafters is expected to grow more slowly than the average for all occupations through the year 2005. However, greater use of computer-aided drafting equipment will increase drafters' productivity and is therefore expected to offset some of the increase in demand for drafting services associated with industrial growth.

Drafters are highly concentrated in industries that are sensitive to cyclical swings in the economy, such as engineering, architectural services and durable goods manufacturing. During recessions, when fewer buildings are designed, drafters may be laid off.

Oklahoma Employment and Outlook

In Oklahoma, drafters are projected to have 139 job openings annually until the year 2000. These job openings represent mostly replacements caused by leaving the occupation, promotions, retirements, etc. rather than new job growth. In 1990, drafters held 3,109 jobs in Oklahoma. They are expected to hold 3,396 jobs by the year 2000. This is considered a slow growth rate due to the relatively large number of drafters employed in Oklahoma in 1990.

Levels of education and training usually needed for this occupation:
- High school diploma with vocational education
- Technical, junior or community college
- Apprenticeship

Levels of education and training also available for this occupation:
- College - bachelor's degree

School subjects helpful in preparing for this occupation:
- Geometry
- Trigonometry
- Computers
- Graphic arts
- Algebra
- Cooperative education — trade and industrial
- Drafting
- Mechanical drawing

MORE SOURCES OF INFORMATION

- Career College Association
  750 1st St., NE
  Suite 900
  Washington, DC 20002-4241

- Education Department
  American Architectural
  Foundation
  1735 New York Avenue, NW

Student Supplement 1

CARPENTER

NATURE OF THE OCCUPATION

Carpenters use hand and power tools to construct, erect, install and repair structures made of wood and wood products according to building codes.

Duties may include but are not limited to the following:

- Studying blueprints, sketches and building plans
- Ordering building materials
- Preparing materials to prescribed measurements using hand and power tools
- Assembling, fastening and installing materials
- Measuring dimensions and trueness of a structure to verify completed work
- Installing or replacing panes of glass, ceiling tiles, doors, cabinets and other furniture

OCCUPATIONAL SPECIALTIES

Rough Carpenters (860.381-042) lay out and build frameworks for buildings, including window and door frames, partitions, sub-flooring and sheathing on outer walls and roofs. They also build concrete forms, scaffolds, platforms, screening fences and temporary shelters on the job site.

Finish Carpenters (860.381-022) lay out and install molding, baseboards, door frames, doors, windows, paneling, cabinets, hardwood floors, stairs, partitions and other interior and exterior trim.

Maintenance Carpenters (860.281-010) construct and repair structural woodwork and equipment according to blueprints, drawings or instructions. They build, repair and install items such as counters, cabinets, benches, partitions, floors and doors.

WORKING CONDITIONS

Carpenters may work alone, with a helper, or with a crew. Some carpenters change employers each time they finish a construction job. Others alternate between working for a contractor and working as contractors themselves on small jobs.

Carpenters may work indoors or outdoors. Prolonged standing, climbing, and squatting often are necessary. Carpenters working indoors normally work 8 hours a day, 5 days a week. Carpenters working outdoors tend to work irregular hours due to weather conditions.

Carpenters may be required to purchase their own hand tools and safety equipment and generally provide their own clothes.

Carpenters may belong to a union such as the United Brotherhood of Carpenters and Joiners of America. Members usually pay periodic dues.

Tools, equipment and materials used may include:

- Blueprints
- Framing squares, rules and calipers
- Glue and putty
- Hand and power tools
- Metal, plastic and concrete
- Nails, screws and tacks
- Pencil, chalk and marking gauges
- Plumb bobs and levels
- Tape measures
- Welding equipment
- Wood and wood products

You should like:

- Working with your hands
- Activities dealing with things, machines and techniques
- Working both independently and as part of a team

You should be able to:

- Work cooperatively with others
- Work within precise standards of accuracy
- Recognize differences in the size, shape and form of lines, figures and objects
- Follow oral and written directions, plans and blueprints
- Use basic math procedures quickly and accurately

Physically you must:

- See well, either naturally or with correction
- Possess eye, hand and finger coordination
- Use your fingers, hands and arms fully

CARPENTER

- Climb and maintain your balance on ladders and scaffolding
- Stoop, kneel, crouch and/or transport objects weighing up to 50 pounds and occasionally more

Opportunities for Experience:

Summer or part-time employment as a carpenter's helper and in co-op programs may be available through vocational centers, high schools or community colleges. All branches of the military service offer opportunities for experience.

Methods for Entry:

Methods of entering this occupation include direct application to employers, taking a civil service exam, or completing a formal apprenticeship program. Positions may also be located by consulting newspaper want ads, school placement offices, local unions or state employment offices.

EARNINGS AND ADVANCEMENT

Earnings depend upon type of work, union affiliation and geographic location.

Earnings:

Nationally in 1995, the average annual income for all carpenters was $29,361. On average, novice carpenters earned $22,142 annually.

Maintenance carpenters employed in metropolitan areas earned an average salary of $34,190 annually. Yearly salaries are affected by bad weather conditions and availability of jobs.

Oklahoma Salary:

Region	Range
Central	9.00-15.50
Northeast	9.00-14.00
Northwest	11.00-14.00
Southwest	9.00-12.00
Southeast	7.25-11.00

Fringe Benefits:

Depending on the employer, carpenters may receive paid vacations and holidays, life, accident, disability and hospitalization insurance, retirement plans and sick pay. These benefits are usually paid, at least in part, by employers.

Career ladder for this occupation may look like this:
- Contractor
- General Contractor
- Superintendent
- Supervisor
- Carpenter
- Apprentice/Trainee

Carpenters may advance through experience, occupational skill level and supervisory ability.

EMPLOYMENT AND OUTLOOK

There were approximately 990,000 carpenters employed nationally in 1992. Carpenters make up the largest group of building trades workers. Employment of carpenters is expected to increase as fast as the average for all occupations through the year 2005 due to increasing construction of new structures and alteration and maintenance of old ones.

Long-term employment growth may be restricted because the increasing use of prefabricated components makes installation much faster and more efficient than in the past. Carpenters with all-around training will have the best prospects.

Oklahoma Employment and Outlook

In Oklahoma, carpenters are projected to have 231 job openings annually until the year 2000. These job openings represent new job growth and replacements caused by leaving the occupation, promotions, retirements, etc. In 1990, carpenters held 5,285 jobs in Oklahoma. They are expected to hold 6,685 jobs by the year 2000. This is considered an average growth rate.

Levels of education and training usually needed for this occupation:
- On-the-job training
- High school diploma with vocational education
- Technical, junior or community college
- Apprenticeship

School subjects helpful in preparing for this occupation:
- Blueprint reading
- Building trades and carpentry
- Shop math
- Woodshop

MORE SOURCES OF INFORMATION

- Technical Director
  United Brotherhood of
  Carpenters and Joiners App.
  & Training Department
  101 Constitution Avenue, NW
  Washington, DC 20001

- Associated Builders &
  Contractors
  729 15th Street, NW
  Washington, DC 20005

- Director, Construction Education
  Service Associated General
  Contractors of America (AGC)
  1957 E Street, NW
  Washington, DC 20006

WELDER

NATURE OF THE OCCUPATION

Welders join metal parts using heat and/or pressure to form a permanent bond. Parts are welded to manufacture products, build structures or to repair broken or cracked parts. Welders generally work from drawings or specifications that are already laid out.

Duties may include but are not limited to the following:

- Selecting proper welding equipment and accessories
- Adjusting equipment to properly weld materials
- Applying proper heat and/or pressure to bond the materials
- Setting machine guides and work-holding devices
- Aligning and feeding the workpiece and removing it after the weld is completed

OCCUPATIONAL SPECIALTIES

Arc Welders (810.384-014) join metal parts using electric welding equipment.

Gas Welders (811.684-014) use an intense gas flame to join metal parts.

Combination Welders (819.384-010) use arc, gas or resistance welding equipment on the same project depending on the materials and type of welding needed.

Production Line Welders (819.684-010) join metal parts on a production line using previously set up gas or arc welding equipment.

WORKING CONDITIONS

Welders may work alone or as part of a team of welders in a plant, building a bridge or performing work on other large projects. Those that work in construction firms normally work outside and may be required to work on scaffolds or platforms. Welders should be able to withstand heat, work in plants that generally are not air-conditioned and at times work in the presence of toxic fumes and gases. To prevent injuries caused by extreme heat, welders usually wear protective clothing, goggles and helmets. Welders usually work a 40-hour week on any one of three shifts. Overtime may be required.

Welders may join a union. Members usually pay dues.

Tools, equipment and materials used may include:

- Cast iron
- Arc and gas welding torches
- Aluminum
- Gas shielded arc equipment
- Nickel
- Submerged arc welding equipment
- Bronze
- Steel

You should like:

- Working with machines and tools
- Activities of a routine, organized nature

You should be able to:

- Work well with others
- Make decisions based on measurable data
- Work accurately and precisely from blueprints or written or oral instructions

Physically you must:

- Stoop, kneel and crouch
- Possess manual dexterity
- See well, either naturally or with correction
- Lift, carry and transport objects weighing up to 100 pounds

Special Requirements:

Generally employers prefer applicants who have had high school or vocational school training in welding.

Opportunities for Experience:

Co-op programs may be available through vocational centers, high schools or community colleges. Formal apprenticeship programs and all branches of the military service also offer opportunities for experience.

Methods for Entry:

Methods of entering this occupation include direct application to employers or local welders' unions. Positions may also be located through an apprenticeship program or by consulting newspaper want ads, school placement offices or local employment offices.

EARNINGS AND ADVANCEMENT

Earnings depend upon the size and type of employer, extent of

WELDER

unionization, geographic location and experience and skill of employee.

Earnings:

Average earnings for first-year welders and welding machine operators were about $20,141 in 1995. Experienced welders can make over $30,000 per year depending on work availability and the local market.

Oklahoma Salary:

Region	Range
Central	10.00-15.50
Northeast	10.00-15.50
Northwest	9.00-19.00
Southwest	5.75-9.00
Southeast	9.00-11.00

Fringe Benefits:

Depending on the employer, welders may receive paid vacations and holidays, sick leave, health, accident and life insurance and participate in a retirement plan. These benefits are usually paid, at least in part, by the employer.

Career ladder for this occupation may look like this:

- Supervisor
- Weld Inspector
- Welder Fitter
- Welder
- Helper or Apprentice

Other workers may be hired as resistance machine operators and advance with experience.

EMPLOYMENT AND OUTLOOK

There were approximately 403,000 welders and cutters employed nationally in 1992. Little or no change is expected in the employment of welders through the year 2005. Most job openings will occur from the need to replace workers who retire, transfer to other occupations or leave the labor force for other reasons.

Oklahoma Employment and Outlook

In Oklahoma, welders are projected to have 268 job openings annually until the year 2000. These job openings represent new job growth and replacements caused by leaving the occupation, promotions, retirements, etc. In 1990, welders held 6,601 jobs in Oklahoma. They are expected to hold 7,723 jobs by the year 2000. This is considered an average growth rate due to the relatively large number of welders employed in Oklahoma in 1990.

Levels of education and training usually needed for this occupation:

- On-the-job training
- Technical, junior or community college
- Apprenticeship

School subjects helpful in preparing for this occupation:

- Blueprint reading
- Cooperative education — trade and industrial
- Electricity and electronics
- Industrial arts
- Machine shop
- Mechanical drawing
- Metal shop
- Shop math
- Shop mechanics
- Welding

MORE SOURCES OF INFORMATION

- Career College Association
  750 1st St., NE, Suite 900
  Washington, DC 20002-4241

- American Welding Society
  550 LeJeune Road, NW
  Miami, FL 33126

Student Supplement 1

Sampling of the Careers in Manufacturing

Student Supplement 1

INDUSTRIAL ENGINEER

NATURE OF THE OCCUPATION

Industrial Engineers determine the most effective ways for an organization to use the basic factors of production — people, machines, materials, information and energy.

Duties may include but are not limited to the following:
- Designing, producing, planning and controlling systems to coordinate activities and control product quality
- Designing or improving systems for the actual distribution of goods and services
- Studying data to determine the functions and responsibilities of workers and work units
- Establishing work measurement programs and making observations to determine the best use of equipment and workers
- Developing programs to simplify work flow, work count, economy of worker motions and layout of units

OCCUPATIONAL SPECIALTIES

Time-Study Engineers (012.167-070) develop work measurement procedures and direct time-and-motion and incentive studies to promote the efficient use of employees and facilities.

Safety Engineers (012.061-014) develop and implement safety programs to prevent or correct unsafe environmental working conditions, using knowledge of industrial processes, mechanics, chemistry, psychology and industrial health and safety laws.

Manufacturing Engineers (012.167-042) plan, direct and coordinate manufacturing processes in industrial plants.

Quality-Control Engineers (012.167-054) plan and direct the development, application and maintenance of quality standards for processing materials into partially-finished or finished products.

WORKING CONDITIONS

Industrial engineers usually work with others as part of a team. They may also supervise other engineers or technicians.

Industrial engineers may work in well-lighted and air-conditioned offices or in production areas where they may be exposed to fumes, noise, extreme temperatures, dust and other plant conditions.

Industrial engineers usually work a 5-day, 40-hour week. Overtime may be required to complete a particular job. Industrial engineers employed by consulting firms may travel extensively.

Industrial engineers may join professional organizations such as the Institute of Industrial Engineers. Members usually pay periodic dues.

Tools, equipment and materials used may include:
- Blueprints
- Specifications
- Charts
- Drafting tools
- Stopwatches
- Plans
- Handbooks
- Computers
- Measuring devices

You should like:
- Activities of a scientific and technical nature
- Activities involving machines, techniques and people
- Activities that require creativity

You should be able to:
- Work within precise limits or standards of accuracy
- Perform a variety of duties that change often
- Think logically
- Perform mathematical calculations quickly and accurately
- Present your ideas effectively in speech and writing
- Observe details in objects or drawings and recognize slight differences in shapes or shadings
- Direct and plan activities

Physically you must:
- See well, either naturally or with correction

Special Requirements:

All fifty states and the District of Columbia have licensing regulations for engineers whose work affects life, health or property. Each state administers its own examination. All states now have legal provisions to grant engineering licensing by reciprocity.

INDUSTRIAL ENGINEER

Not all engineers need to be licensed. The exceptions are engineers working (1) for the federal government, (2) in a manufacturing or interstate commerce corporation, (3) in a public service corporation or (4) as subordinates to registered engineers. However, the trend is toward licensing for everyone.

Opportunities for Experience:
Summer or part-time work with research laboratories, manufacturing plants and construction projects offer opportunities.

EARNINGS AND ADVANCEMENT

Earnings depend upon the employer and employee's experience and education.

Earnings:
In 1995, an industrial engineer with a bachelor's degree averaged a first-year income of $35,244. The top 10 percent of the starting offers averaged $39,600, with the bottom 10 percent of starting offers averaging $30,000. Those with master's degrees earned starting salaries of $39,695. With greater experience and advanced education, salary averages rose to $54,662 after 12 years.

Oklahoma Salary:

Region	Range
Central	19.00-23.00
Northeast	14.00-23.00
Northwest	13.00-23.00
Southwest	--
Southeast	--

Fringe Benefits:
Depending on the employer, industrial engineers may receive paid vacations and holidays, life and hospitalization insurance, retirement plans and paid sick leave. Many employers will also pay expenses for additional education.

Career ladder for this occupation may look like this:
- Supervisor
- Industrial Engineer
- Trainee

Industrial engineers may advance through experience, supervisory ability and additional education.

EMPLOYMENT AND OUTLOOK

There were an estimated 119,000 industrial engineers employed nationally in 1992. Employment of industrial engineers is expected to grow about as fast as the average for all occupations through the year 2005 due to increasing industrial growth and the greater use of automation in factories and in offices. Jobs will also be created as firms seek to reduce costs and increase productivity through scientific management and safety engineering.

Oklahoma Employment and Outlook

In Oklahoma, industrial engineers are projected to have 45 job openings annually until the year 2000. These job openings represent new job growth and replacements caused by leaving the occupation, promotions, retirements, etc. In 1990, industrial engineers held 1,027 jobs in Oklahoma. They are expected to hold 1,247 jobs by the year 2000. This is considered an average growth rate.

Levels of education and training usually needed for this occupation:
- Technical, junior or community college
- College - bachelor's degree
- College - master's degree

Levels of education and training also available for this occupation:
- College - Ph.D. or professional degree

School subjects helpful in preparing for this occupation:
- College preparatory
- English
- Calculus
- Statistics
- Chemistry
- Physics
- Blueprint reading
- Machine shop
- Shop mechanics
- Composition
- Algebra
- Geometry
- Trigonometry
- Physical science
- Humanities
- Drafting
- Mechanical drawing

MORE SOURCES OF INFORMATION

- National Society of Black Engineers (NSBE)
  1454 Duke St., P.O. Box 25588
  Alexandria, VA 22314

- Junior Engineering Technical Society (JETS)
  1420 King Street, Suite 405
  Alexandria, VA 22314-2715

- Customer Service
  Institute of Industrial Engineers
  25 Technology Park/Atlanta
  Norcross, GA 30092

- American Society for Quality Control
  611 East Wisconsin Avenue
  P.O. Box 3005
  Milwaukee, WI 53203-3005

- Educational Department
  American Society of Safety Engineers
  1800 East Oakton
  Des Plaines, IL 60018

Student Supplement 1

CHEMICAL ENGINEER

NATURE OF THE OCCUPATION

Chemical Engineers design chemical plant equipment and devise processes for manufacturing chemicals and products such as gasoline, synthetic rubber, plastics, detergents, cement, paper and pulp.

Duties may include but are not limited to the following:
- Conducting research to develop new chemical manufacturing processes
- Determining the best method for operations like mixing, crushing, heat transfer, distillation and oxidation
- Making recommendations to management concerning new manufacturing processes, location and/or design of a new plant or modification of an existing plant

OCCUPATIONAL SPECIALTIES

Chemical Engineers (008.061-018) specialize in a particular application such as research, product development or design, plant construction or operation, technical sales or management. They design equipment and develop processes for manufacturing chemicals and related products utilizing principles of natural and physical sciences.

Chemical Process Design Engineers (008.061-014) design equipment and processes to produce chemical changes in elements and compounds.

Chemical Research Engineers (008.061-022) conduct research on chemical processes and equipment to test or modify engineering theory.

Chemical Test Engineers (008.061-026) supervise and use instruments, equipment and control devices necessary to test, record and simplify chemical processes. They conduct tests to check the performance of chemicals and fuels.

Chemical-Engineering Technicians (008.261-010) apply chemical engineering principles and technical skills to assist chemical engineers in developing, improving and testing chemical-plant processes, products and equipment. They prepare charts and diagrams, and record engineering data on to clarify design data.

WORKING CONDITIONS

Chemical engineers usually perform part of their work in modern, climate-controlled laboratories. Most chemical engineers work in manufacturing industries, primarily those producing chemicals, petroleum and related products. Extremes in temperature, machine noise and disagreeable odors may be experienced.

Chemical engineers work with other scientists such as chemists, metallurgists, physicists, non-professional helpers and engineering technicians.

Generally, chemical engineers work 8 hours a day, 5 days a week. They may work irregular hours when emergencies occur, when deadlines must be met or when new processes go into effect.

Chemical engineers may join one or more professional associations such as the American Chemical Society or the American Institute of Chemical Engineers. Association members usually pay annual dues.

Tools, equipment and materials used may include:
- Absorption and evaporation towers
- Columns
- Computers
- Condensers
- Drafting tools
- Slide rules
- Stills

You should like:
- Solving problems of a scientific and technical nature
- Performing work that requires creativity

You should be able to:
- Work within set limits and tolerances
- Evaluate information using measurable standards
- Exercise high-level judgment
- Demonstrate imagination, reliability and patience
- Work under pressure
- Express yourself well in writing and speech

Physically you must:
- Work in an atmosphere of dust and fumes
- See well, either naturally or with correction
- Have good use of arms, hands and fingers

Special Requirements:

All 50 states and the District of Columbia have licensing regulations for engineers whose work affects life, health or property. Each state administers its own examination. All states now have legal provisions to grant engineering licensing by reciprocity.

Not all engineers need to be licensed. The exceptions are engineers working (1) for the federal government, (2) in a manufacturing corporation or a corporation engaged in interstate commerce, (3) in a public service corporation, and (4) as subordinates to registered engineers. However, the trend is toward licensing for everyone.

Opportunities for Experience:

A co-op program in college is a good way to gain experience.

CHEMICAL ENGINEER

Because of the technical nature of the occupation, opportunities for summer employment are limited.

Methods for Entry:

Large corporations often send recruiters to college and university placement bureaus to interview students. Placement offices also maintain lists of prospective employers and job openings. Professional societies may help by advertising in magazines and by providing interviewing facilities at professional meetings.

EARNINGS AND ADVANCEMENT

Earnings of chemical engineers depend on educational background, experience and ability and on the type, size and location of the employing organization.

Earnings:

In 1995, a chemical engineer graduating with a bachelor's degree earned an average annual starting salary of $39,863. The top 10 percent of offers to students with bachelor's degrees was $44,000, while the bottom 10 percent of offers averaged $33,000. Chemical engineers with a master's degree began at a salary level of $42,117 per year, while those with a Ph.D. earned an average of $55,271 their first year.

Oklahoma Salary:

Region	Range
Central	23.00-Over
Northeast	25.00-35.00
Northwest	--
Southwest	--
Southeast	--

Fringe Benefits:

Depending on the employer, chemical engineers receive paid vacations and holidays, life, accident, disability and hospitalization insurance, retirement plans and sick pay. In addition, some employers offer chemical engineers the opportunity to buy stock in the company.

Career Ladder for this Occupation May Look like this:

- Management or Executive Position
- Chief Engineer
- Engineer
- Junior Engineer or Assistant

Chemical engineers' diverse training and experience make them ideally suited to managerial positions.

EMPLOYMENT AND OUTLOOK

There were over 52,000 chemical engineers employed nationally in 1992. Seventy percent were in manufacturing industries, primarily in the chemical, petroleum refining and related industries. Most of the rest worked for engineering services, consulting firms, or for government agencies.

Employment is expected to grow as fast as the average for all occupations through the year 2005. Most job openings will result from the need to replace chemical engineers who transfer to other occupations. Areas relating to the production of chemicals, biotechnology and materials science may provide better opportunities than other portions of the chemical industry. Much of the projected growth will be in nonmanufacturing industries, especially service industries.

Oklahoma Employment and Outlook

In Oklahoma, chemical engineers are projected to have 18 job openings annually until the year 2000. These job openings represent new job growth and replacements caused by leaving the occupation, promotions, retirements, etc. In 1990, chemical engineers held 551 jobs in Oklahoma. They are expected to hold 605 jobs by the year 2000. This is considered a slow growth rate.

Levels of education and training usually needed for this occupation:

- College - bachelor's degree
- College - master's degree

Levels of education and training also available for this occupation:

- College - Ph.D. or professional degree

School subjects helpful in preparing for this occupation:

- Algebra
- Blueprint reading
- Calculus
- Chemistry
- College preparatory
- Composition
- Computer science
- Drafting
- Geometry
- Humanities
- Physics
- Social studies
- Trigonometry

MORE SOURCES OF INFORMATION

- Career Guidance Department
  American Institute of Chemical Engineers
  345 East 47th Street
  New York, NY 10017

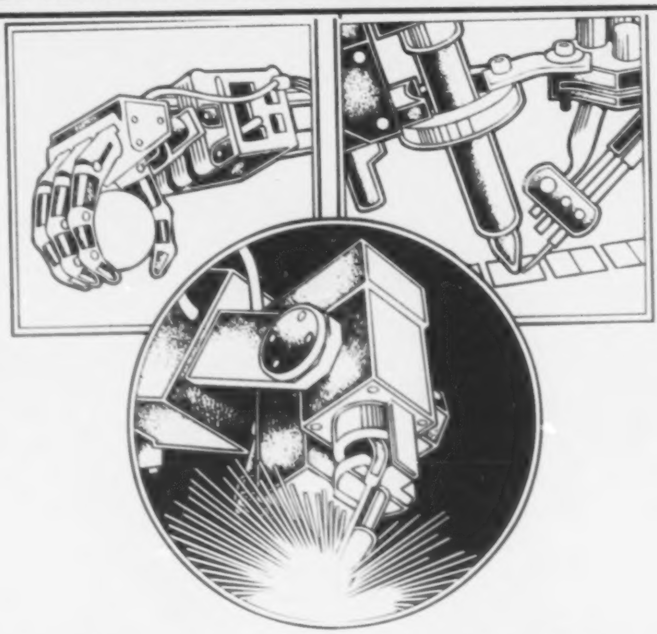
- American Chemical Society
  Ed. Division, Career Publications
  1155 16th Street, NW
  Washington, DC 20036

- American Institute of Chemists
  7315 Wisconsin Avenue
  Bethesda, MD 20814

- National Society of Black Engineers (NSBE)
  1454 Duke St., P.O. Box 25588
  Alexandria, VA 22314

- Junior Engineering Technical Society (JETS)
  1450 King Street
  Alexandria, VA 22314-2715

METALLURGICAL/MATERIALS ENGINEER



NATURE OF THE OCCUPATION

Metallurgical engineers develop new kinds of metals and other materials that meet special requirements. The three main branches of metallurgy are extractive, physical and mechanical. Extractive metallurgists remove metals from ores and refine and alloy them to obtain useful metal. Physical metallurgists study the physical properties, nature, structure and the methods of converting refined metals into final products. Mechanical metallurgists develop and improve the processes of metalworking.

Duties may include but are not limited to the following:

- Conducting research and development
- Testing metals and alloys
- Supervising production processes
- Consulting with other engineers and officials
- Selling and servicing metal products

OCCUPATIONAL SPECIALTIES

Foundry Metallurgists (011.061-010) conduct research to develop and improve sand molding, melting, alloying and metal pouring methods.

Metallographers (011.061-014) conduct tests on metals and alloys for developing new and improved metals and alloys and improving production methods.

Extractive Metallurgists (011.061-018) extract metals from ores through processes such as smelting or refining, develop uses for scrap metal and low grade ores, control temperature and charge mixtures furnaces.

Physical Metallurgists (011.061-022) study the structure of metals in order to develop new alloys, new uses for metals through alloying and ways to produce them commercially.

Welding Engineers (011.061-026) specialize in the development and application of welding equipment and welding techniques for hard-to-weld metal alloys and assemblies.

Materials Engineers (019.061-014) evaluate technical and economic factors towards the recommendation of engineering and manufacturing strategies to attain design objectives of products and processes by applying their knowledge of material science and related technologies.

WORKING CONDITIONS

Metallurgical and materials engineers may work alone or with other members of an engineering team under the general supervision of a chief engineer. They may supervise the work of technicians or other workers.

Metallurgical and materials engineers generally work in offices and laboratories that are well-lighted and ventilated. Some may work in mills, mines or plants.

Metallurgical and materials engineers usually work a 40-hour week. Overtime may be required to complete projects. Traveling may also be required.

Metallurgical and materials engineers may join organizations such as the American Institute of Mining, Metallurgical, and Petroleum Engineers and the American Society for Metals. Members usually pay periodic dues.

Tools, equipment and materials used may include:

- Photographic equipment
- Microscopes and metallographs
- Mechanical testing equipment
- Melting, welding and extrusion equipment
- Computers
- Electron microscopes and microprobes
- Machinery for forming metals
- Heat-treating furnaces

You should like:

- Activities dealing with things and objects
- Activities of a scientific and technical nature
- Activities of an abstract and creative nature

BEST COPY AVAILABLE

METALLURGICAL/MATERIALS ENGINEER

You should be able to:
- Use logical step-by-step procedures to complete tasks
- Work within set limits or standards
- Follow detailed instructions
- Understand mathematics and concepts
- Recognize differences in the size, shape and form of lines and figures
- Visualize objects from drawings or diagrams
- Plan and direct the activities and work of others

Physically you must:
- See well, either naturally or with correction
- Reach, handle and finger objects and materials

Special Requirements:

All fifty states and the District of Columbia have licensing regulations for engineers whose work affects life, health, or property. Registration generally requires a degree from an accredited engineering program, four years of relevant work experience and passing a state examination. Graduate training is required for engineering faculty positions and it is helpful for other positions as a way to learn new technology and to enhance promotion opportunities.

EARNINGS AND ADVANCEMENT

Earnings depend upon the employer and the employee's education, experience and specialty.

Earnings:

Metallurgical and materials engineers with a bachelor's degree earned starting salaries in 1995 averaging $35,275. Those with a master's degree averaged first-year salaries of $39,500 while those with a Ph. D. were offered $53,143 to start. Experienced engineers without a master's degree or Ph.D had annual incomes averaging $50,100 in 1995.

Oklahoma Salary:

No figures were available for a regional hourly median wage. However, the statwide hourly median wage for metallurgical/materials engineers is $15.50 to $19.00.

Fringe Benefits:

Depending on the employer, metallurgical engineers may receive paid vacations and holidays, life and hospitalization insurance and paid sick leave. These are paid, at least in part, by the employer.

Career ladder for this occupation may look like this:
- Chief Metallurgical Engineer
- Metallurgical Supervisor
- Metallurgical Engineer
- Engineering Trainee

Metallurgical and materials engineers may advance through experience and/or additional education. For teaching positions in colleges and universities, a Ph.D. degree is usually required. About half of all metallurgical engineers employed in research and development work have a Ph.D.

EMPLOYMENT AND OUTLOOK

There were approximately 19,000 metallurgical and materials engineers employed nationally in 1992. Employment is expected to grow faster than the average for all occupations through the year 2005.

Metallurgical and materials engineers will be needed to develop new materials and alloys, adapt current ones to new needs and improve ways of recycling solid waste and processing low-grade ores. As the supply of high-grade ores diminishes, more metallurgical engineers will be required to develop new ways of recycling solid waste materials and processing low-grade ores now considered unprofitable to mine. Most job openings, however, will result from the need to replace engineers who retire or transfer to other occupations.

Oklahoma Employment and Outlook

In Oklahoma, metallurgical engineers are projected to have 12 job openings annually until the year 2000. These job openings represent new job growth and replacements caused by leaving the occupation, promotions, retirements, etc. In 1990, metallurgical engineers held 254 jobs in Oklahoma. They are expected to hold 315 jobs by the year 2000.

Levels of education and training usually needed for this occupation:
- College - bachelor's degree
- College - master's degree

Levels of education and training also available for this occupation:
- College - Ph.D. or professional degree

School subjects helpful in preparing for this occupation:
- Algebra
- Computer science
- Trigonometry
- Earth science
- Physics
- Welding
- English
- Calculus
- Geometry
- Chemistry
- Physical science
- Machine shop

MORE SOURCES OF INFORMATION

- The Minerals, Metals & Materials Society
  420 Commonwealth Dr.
  Warrendale, PA 15086

- Nat'l. Society of Black Eng. (NSBE)
  1454 Duke St., P.O. Box 25588
  Alexandria, VA 22314

- ASM International
  Student Outreach Program
  Materials Park, OH 44073-0002

Student Supplement 1

METAL/PLASTIC WORKING MACHINE OPERATOR

NATURE OF THE OCCUPATION

Plastic and metalworking machine operators run the machines that produce thousands of parts that are used in automobiles and nearly every other manufactured product. The operators set up and/or operate metal cutting machines such as lathes, shapers and milling machines.

Duties may include but are not limited to the following:
- Reading blueprints and working orders to determine tooling instructions
- Positioning cutting tools and workpieces for correct operations
- Determining cutting speeds, feed rates and cutting tools to be used
- Starting machine and controlling its operation
- Removing chips and controlling coolant systems
- Making minor adjustments or tool changes
- Performing routine machine maintenance burring
- Stacking or loading finished items in shipping containers or placing items on a conveyor system

OCCUPATIONAL SPECIALTIES

Lathe Tenders (604.685-026) tend one or more previously set-up lathes such as turret lathes, engine lathes and chucking machines, to perform one or a series of repetitive operations such as turning, boring, threading or facing metal workpieces.

Milling-Machine Tenders (605.685-030) set up and operate various types of milling machines to mill flat or curved surfaces on metal workpieces, such as machine, tool or die parts.

WORKING CONDITIONS

Skilled plastic and metalworking machine operators generally work in the specialized production departments or tool rooms of factories or job shops under the direction of section leaders and/or supervisors.

Most plastic and metalworking machine operators work a 5-day, 40-hour week. Some workers are employed on afternoon and night shifts. Overtime may be necessary at times to meet production requirements or contract deadlines.

Most plastic and metalworking machine operators are members of unions including the International Association of Machinists and Aerospace Workers, the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America or the United Steelworkers of America. Metalworking machine operators who belong to unions are required to pay dues.

Tools, equipment and materials used may include:
- Wrenches
- Mallets and hammers
- Punches and chisels
- Micrometers
- Dial indicators
- Templates
- Clamps
- Vises and scales
- Blueprints
- Squares and protractors
- Air, depth and surface gauges

You should like:
- Working with objects
- Performing routine, concrete and organized work
- Activities of a mechanical nature
- Working with your hands

You should be able to:
- Do exacting work according to specifications
- Solve shop math calculations
- Plan and carry out an entire activity

Physically you must:
- See well, either naturally or with correction
- Stand for extended periods
- Have good depth perception
- Coordinate hand and eye movements
- Lift heavy objects weighing up to about 75 pounds

Opportunities for Experience:

There are several ways to explore or gain experience in the field of machine metalworking. They include summer or part-time work as a helper or laborer in a machine shop and co-op programs usually available through a high school, vocational center or community college.

Methods for Entry:

Methods of entering this occupation include direct application to factories or machine shops. High school and state Employment Security Commission placement offices, local unions and consulting newspaper want ads also provide assistance.

EARNINGS AND ADVANCEMENT

Earnings of plastic and metalworking machine operators vary greatly according to the skill level of the individual industry worked in, type of machine operated, geographic location, size

METAL/PLASTIC WORKING MACHINE OPERATOR

of employer and extent of unionization.

Earnings:

Plastic and metalworking machine operators averaged $452 weekly in 1995, for an average annual salary of $23,560. The middle 50 percent earned between $333 and $586 per week. The top 10 percent earned over $702 and the bottom 10 percent earned less than $254. Metal and plastics processing machine operators' weekly earnings were slightly lower, with median weekly earnings of about $398 and the middle 50 percent earned between $278 and $546.

However, earnings of production workers vary considerably by industry. Average weekly wages for production workers in industries where employment of plastics and metalworking machine operators in concentrated are shown in the following tabulation.

Transportation equipment	$672
Plastics materials and resins	632
Primary metals industries	601
Machinery, except electrical	539
Fabricated metal products	488

Oklahoma Salary:

Region	Range
Central	Under-9.00
Northeast	7.25-11.00
Northwest	--
Southwest	--
Southeast	--

Fringe Benefits:

Depending on the employer, most metal and plastic working machine operators receive paid vacations and holidays, life, accident, disability, and hospitalization insurance, retirement plans and sick pay. These benefits are usually paid, at least in part, by employers.

Career ladder for this occupation may look like this:

- Tool and Die Maker
- Machinist
- Skilled Machine Operator
- Semi-skilled Machine Operator
- Trainee

EMPLOYMENT AND OUTLOOK

Nationally, there were about 1,378,000 metalworking and plastic-working machine operators employed in 1992. Overall employment is expected to decline through the year 2005.

Employment of steel industry operators is expected to decline due to further reductions in domestic steel production and increasing automation, while employment for those in the plastics industry should increase as their industry expands. Job openings will continue to occur as operators transfer to other fields of work or retire.

Oklahoma Employment and Outlook

No data available.

Levels of education and training usually needed for this occupation:

- On-the-job training
- High school diploma or G.E.D.

School subjects helpful in preparing for this occupation:

- English
- Machine shop
- Shop math
- Industrial arts
- Metal shop
- Blueprint reading

MORE SOURCES OF INFORMATION

- Training Director
  Association for Manufacturing Technology
  7901 Westpark Drive, Box 1312
  McLean, VA 22102-4269
- Attn: Career Information
  Tooling & Manufacturing Association
  1177 S. Dee Road
  Park Ridge, IL 60068

Student Supplement 1

PUBLIC RELATIONS SPECIALIST

NATURE OF THE OCCUPATION

Public relations specialists plan and conduct public relations programs to promote products, ideas, companies or people. They influence opinions through promotional techniques and two-way communication.

Duties may include but are not limited to the following:

- Determining the needs of the organization or individual
- Preparing and distributing fact sheets, photographs, articles, news releases and/or promotional booklets
- Making speeches and conducting research
- Directing advertising campaigns in all types of media
- Coordinating special exhibits, contests or luncheons into the total public relations plan

OCCUPATIONAL SPECIALTIES

Lobbyists (165.017-010) contact and confer with members of the legislature and other holders of public office to persuade them to support legislation favorable to their clients' interests.

Fundraising Directors (165.117-010) direct and coordinate the solicitation and disbursement of funds for community social-welfare organizations. They establish fund-raising goals according to the financial need of the agency and formulate policies for collecting and safeguarding the contributions.

Funds Development Directors (165.117-014) plan, organize and coordinate ongoing and special project funding programs for museums, zoos, public broadcasting stations and similar institutions. They prepare a statement of planned activities and enlist support from members of the institution staff and volunteer organizations.

Public Relations Representatives (165.167-014) plan and coordinate public relations programs that are designed to create and maintain a favorable public image for employers and clients.

Sales-Service Promoters (165.167-010) generate sales and create good will for a firm's products by preparing displays and touring the country. They call on merchants to advise them of ways to increase sales and demonstrate products.

WORKING CONDITIONS

Public relations specialists may work alone or with a team on a particular project. The work is often done in comfortable, well-lighted, and well-ventilated offices.

Public relations specialists usually work 35 to 40 hours a week, 5 days a week. A public relations specialist's routine consists of preparing and delivering speeches, attending meetings and community activities, and out-of-town travel. Their schedules often have to be rearranged to meet deadlines and changes in their planned activities. Often overtime is required, and sometimes specialists are on call around the clock, especially if there is an emergency or crisis.

Public relations specialists may belong to the Public Relations Society of America. Members pay periodic dues.

Tools, equipment and materials used may include:

- Typewriters
- Cameras
- Telephones
- Audiovisual equipment
- Surveys and reports
- Showcases
- Charts
- Interview forms
- Account records

You should like:

- Communicating with people
- Abstract and creative work
- Troubleshooting and problem-solving

You should be able to:

- Be persuasive and react to people's ideas and attitudes
- Project self-confidence and speak clearly and calmly
- Effectively communicate ideas and information both verbally and in writing
- Evaluate information and make quick judgments and decisions
- Plan, control and complete projects from start to finish
- Deal with all types of people in various situations

Physically you must:

- Lift and carry light materials
- See and hear well, either naturally or with correction
- Deal calmly with stressful and emotional situations

Opportunities for Experience:

Summer work at radio and television stations, at newspaper offices, and volunteer work with charitable and community organizations can provide experience in this field.

PUBLIC RELATIONS SPECIALIST

Methods for Entry:

One method is to apply directly to civil service offices, advertising agencies, newspapers, radio and television stations, businesses or industries. Assistance may also be obtained from college placement offices and newspaper want ads.

EARNINGS AND ADVANCEMENT

Earnings vary by the type of business, location and size of employer. Private consulting firms generally pay more than companies that have their own public relations departments. Those who work in public relations firms often receive substantial salary increases based on successful performance.

Earnings:

In 1995 public relations graduates earned an average starting salary of $20,737. Average earnings for experienced specialists were $38,547. The middle 50 percent earned between $22,664 and $46,330 a year. The top 10 percent of public relations practitioners in all organizations earned an average salary of more than $58,760, and the lowest 10 percent earned less than $16,950.

Average salaries vary widely by type of employer. Manufacturers, utilities and public relations counseling firms are among the highest paying employers; museums and miscellaneous nonprofit organizations, religious and charitable organizations, and hotels and resorts are among the lowest paying employers.

In the federal government, those with a bachelor's degree generally earned starting salaries of $23,060 a year in 1995; those with a master's degree earned $28,219. Public affairs specialists in the federal government averaged $45,568 in 1995.

Oklahoma Salary:

Region	Range
Central	11.00-15.50
Northeast	11.00-15.50
Northwest	--
Southwest	--
Southeast	--

Fringe Benefits:

Public relations specialists may receive an expense account, hospital and life insurance, sick leave, paid vacations and holidays and retirement plans. These benefits are usually paid, at least in part, by the employer.

Career ladder for this occupation may look like this:
- Own Business
- Supervisor
- Public Relations Specialist
- Public Relations Trainee

A successful career depends on individual ability, initiative, self-confidence, desire, capacity for hard work, and experience.

EMPLOYMENT AND OUTLOOK

Nationally, there were approximately 98,000 public relations specialists employed in 1992. Employment is expected to grow as fast as the average for all occupations through 2005 as corporations, associations, medical centers, and other large organizations expand their public relations efforts. There will be keen competition for beginning jobs since the diversified nature of the occupation attracts many applicants. Prospects for a career in public relations are best for highly qualified applicants — talented people with sound academic preparation and some media experience.

Oklahoma Employment and Outlook

In Oklahoma, public relations specialists are projected to have 45 job openings annually until the year 2000. These job openings represent new job growth and replacements caused by leaving the occupation, promotions, retirements, etc. In 1990, public relations specialists held 1,000 jobs in Oklahoma. They are expected to hold 1,143 jobs by the year 2000. This is considered an average growth rate.

Levels of education and training usually needed for this occupation:
- Technical, junior or community college
- College - bachelor's degree
- Internship

School subjects helpful in preparing for this occupation:
- College preparatory
- English
- Speech
- Humanities
- Sociology
- Advertising
- Creative writing
- Composition
- Journalism
- Typing
- Psychology
- Political science
- Business courses

MORE SOURCES OF INFORMATION

- American Assoc. of Advertising Agencies
  666 Third Avenue, 13th Floor
  New York, NY 10017

Student Supplement 1

Sampling of the Careers in Energy, Power, and Transportation

STUDENT SUPPLEMENT 1

Student Supplement 1

AEROSPACE ENGINEER

NATURE OF THE OCCUPATION

Aerospace engineers design, develop and test commercial and military aircraft, missiles, surface-effect vehicles and spacecraft. They develop new technologies in commercial aviation, defense systems and space exploration.

Duties may include but are not limited to the following:
- Designing and developing aircraft
- Overseeing the manufacture of prototypes (models)
- Testing prototypes to evaluate their operation
- Estimating the time and cost to complete projects

OCCUPATIONAL SPECIALTIES

Aerodynamists (002.061-010) analyze the suitability and application of designs for aircraft and missiles. They also plan and evaluate the results of laboratory and flight-test programs.

Field Service Engineers (002.167-014) study performance reports on aircraft and recommend ways of eliminating the causes of flight and service problems in airplanes.

Stress Analysts (002.061-030) study the ability of airplanes, missiles, and components to withstand stress during flight.

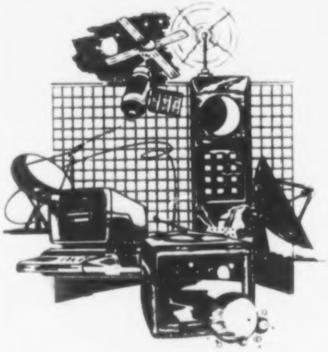
Aeronautical Test Engineers (002.061-018) plan and supervise the performance testing of aerospace and aircraft products.

Aeronautical Design Engineers (002.061-022) develop basic design concepts used in the design, development and production of aeronautical/aerospace products and systems.

Value Engineers (002.167-010) plan and coordinate engineering activities to develop and apply standardized production requirements for parts and equipment used in aircraft and aerospace vehicles.

Aeronautical Project Engineers (002.167-018) direct and coordinate activities of personnel who design systems and equipment for aeronautical and aerospace products.

Aeronautical Drafters (002.261-010) draft engineering drawings and other equipment, and scale models of prototype aircraft planned by engineers.



WORKING CONDITIONS

Aerospace engineers work in offices or in laboratories, factories and testing sites. Aerospace engineers may have to sit at drawing boards for long periods of time. They may also be subject to the noise of equipment and machinery used to test airplanes.

Aerospace engineers usually work a 5-day, 40-hour week, though there may be great pressure to meet deadlines or design standards, and longer hours under considerable stress may be required.

Occasionally, travel to testing sites may be necessary, and traveling can often be quite extensive.

Aerospace engineers may join professional organizations such as the American Institute of Aeronautics and Astronautics and the National Society of Professional Engineers. Members usually pay dues.

Tools, equipment and materials used may include:
- Blueprints
- Specifications
- Preliminary plans
- Light tables
- Charts and handbooks
- Measuring scales
- Weight scales
- Drafting tools
- Computers

You should like:
- Working with scientific and technical data
- Putting abstract concepts into practical use through scientific and mathematical strategies

You should be able to:
- Perform a variety of duties that may change often
- Think logically and use good judgment
- Work within precise limits and standards of accuracy
- Visualize three-dimensional objects from drawings or diagrams
- Communicate well, both orally and in writing
- Work well as part of a team

Physically you must:
- Have speech and hearing (depending upon area of work)
- See well, either naturally or with correction
- Be able to reach, handle, finger, and feel
- Be able to effectively deal with stress and stressful situations

Special Requirements:

Aerospace engineers who have primary responsibility for a project or who must sign off a contract generally are required to be licensed by the state in which they work. All 50 states and the District of Columbia require registration for engineers. Graduate work is essential for engineering faculty positions, but for the majority of

BEST COPY AVAILABLE

AEROSPACE ENGINEER

entry-level positions, a bachelor's degree is sufficient.

Opportunities for Experience:
Opportunities for experience and exploration are available through work/study programs at colleges and universities and service in the United States Air Force. Summer or part-time work with research laboratories, manufacturing plants and construction projects will provide an idea of what is involved in engineering.

Methods for Entry:
Methods of entering this occupation include direct application to employers and civil service offices. Assistance in locating a job may be available through college and university placement offices.

EARNINGS AND ADVANCEMENT

Earnings depend on the individual's education, experience, field of specialization and job duties.

Earnings:
The average salary offer to college graduates with a bachelor's degree in aerospace engineering was $32,219 in 1995. The top 10 percent of offers averaged 38,000, while the bottom 10 percent averaged 28,800. Graduates with a master's degree earned average starting salaries of $42,000. Yearly average salaries of experienced aerospace engineers was $59,554. The average salary for all engineers in the federal government was $54,206.

Fringe Benefits:
Depending on the employer, aerospace engineers may receive paid vacations and holidays, life, accident, disability, and hospitalization insurance, retirement plans and sick pay. These benefits are usually paid, at least in part, by employers.

Career ladder for this occupation may look like this:

- Chief Engineer
- Aeronautical or Astronautical Engineer
- Trainee

Aerospace engineers may advance to administrative and other executive positions or become consultants.

EMPLOYMENT AND OUTLOOK

There were approximately 66,000 aerospace engineers employed nationally in 1992. Defense spending for military aircraft, missiles and other aerospace systems is expected to decline, making employment in this field very competitive.

Growth in the civilian aviation market is expected to be slower than anticipated due to ongoing financial difficulty in the airline industry.

Oklahoma Employment and Outlook

In Oklahoma, aerospace engineers are projected to have 18 job openings annually until the year 2000. These job openings represent new jobs and replacements caused by leaving the occupation, promotions, retirements, etc. In 1990, aerospace engineers held 452 jobs in Oklahoma. They are expected to hold 518 jobs by the year 2000. This is considered an average growth rate.

Levels of education and training usually needed for this occupation:

- College - bachelor's degree
- College - master's degree

Levels of education and training also available for this occupation:

- College - Ph.D. or professional degree

School subjects helpful in preparing for this occupation:

- College preparatory
- Algebra
- Geometry
- Trigonometry
- Physics
- English
- Calculus
- Statistics
- Chemistry
- Electricity and electronics

MORE SOURCES OF INFORMATION

- Student Programs Dept.
  American Institute of Aeronautics and Astronautics
  370 L'Enfant Promenade, SW
  Washington, D.C. 20024-2518

- American Astronautical Society
  6352 Rolling Mill Place, Suite 102
  Springfield, VA 22152

- National Society of Black Engineers (NSBE)
  1454 Duke St., P.O. Box 25588
  Alexandria, VA 22314

- Junior Engineering Technological Society (JETS)
  1420 King Street, Suite 405
  Alexandria, VA 22314-2715

- National Society of Professional Engineers
  Information Center
  1420 King Street
  Alexandria, VA 22314

- Institute for the Advancement of Engineering
  24300 Calvert St.
  Woodland Hills, CA 91367-1113

Student Supplement 1

GEOLOGIST AND GEOPHYSICIST

NATURE OF THE OCCUPATION

Geologists study the structure, composition and history of the earth's crust. Geologists and geophysicists play an increasingly important role in studying, monitoring and cleaning up the environment.

Duties may include but are not limited to the following:

- Examining rocks, minerals and fossil remains
- Determining and explaining the sequence of the earth's development
- Interpreting research data
- Recommending specific studies or actions
- Preparing reports and maps
- Managing and cleaning up toxic waste

OCCUPATIONAL SPECIALTIES

Geologists, Petroleum (024.061-022) study the earth's surface and subsurface to locate gas and oil deposits and help develop extraction processes.

Mineralogists (024.061-038) examine, analyze and classify minerals, gems and precious stones and study their occurrence and chemistry.

Paleontologists (024.061-042) study the fossilized remains of plants and animals to determine the development of past life and history of the earth.

Hydrologists (024.061-034) study the distribution and development of water in land areas and evaluate findings in reference to such problems as flood and drought, soil and water conservation and inland irrigation.

Oceanographers, Geological (024.061-018) study the ocean bottom.

Oceanographers, Physical (024.061-030) study the physical aspects of oceans such as currents and their interaction with the atmosphere.

Seismologists (024.061-050) interpret data from seismographs and other instruments to locate earthquakes and earthquake faults.

Stratigraphers (024.061-054) study the distribution and arrangement of sedimentary rock layers by examining their contents.

WORKING CONDITIONS

Most geologists and geophysicists divide their time between fieldwork and office or laboratory work. Geologists often travel to remote field sites by helicopter or jeep and cover large areas by foot.

Working in the office, the work week is usually a regular 40-hour week. Field studies may require long and irregular hours.

Exploration geologists may receive assignments of varying length, and destinations and may be required to travel to different parts of the United States or foreign countries. Geological and physical oceanographers may spend considerable time at sea.

Geologists may join professional organizations such as the Geological Society of America and the American Association of Petroleum Geologists. Members usually pay dues.

Tools, equipment and materials used may include:

- Compasses
- Seismographs
- Clinometers
- Core drills
- Gravity meters
- Hammers and chisels
- Cameras
- X-ray diffraction/fluorescence spectrometers
- Visible, infrared and side-scanning radar
- Transits
- Levels
- Microscopes
- Electron microscopes
- Atomic absorption spectrophotometers
- Records
- Petrographic microscopes

You should like:

- Problem solving
- Scientific and technical work
- Activities of an abstract and creative nature
- Work involving objects
- Outdoor work

You should be able to:

- Apply scientific and mathematical theory to real problems
- Perform research
- Work accurately within set limits and standards
- Perceive and record differences in the size, shape, form, texture and position of objects
- Work well with others
- Prepare written reports

Physically you must:

- See well, either naturally or with correction
- Stoop, kneel, crouch, climb and balance
- Reach for, handle and hold instruments
- Lift and carry objects weighing up to 50 pounds

GEOLOGIST AND GEOPHYSICIST

Special Requirements:

Registration will soon be required of most geologists. This is a result of federal regulation for environmental protection. Registration will be through state licensing boards and basically will require a minimum of a bachelor's degree and passing an exam and/or work experience. At the present time, ten states now have registration requirements.

EARNINGS AND ADVANCEMENT

Earnings depend upon the geologist's particular position, occupational specialty, amount of experience and level of education.

Earnings:

Geologists and geophysicists graduating with a bachelor's degree in 1995 earned average starting salaries of $29,464. Starting salaries can vary widely depending on the employing industry. These income averages can easily go into the $40,000 to $60,000 per year range with 6 or more years of experience.

Those who obtain their master's degree in geology or geophysics are likely to be offered first-year employment at $47,000 annually. Geologists and geophysicists with a Ph.D. can expect to earn even more.

Oklahoma Salary:

Region	Range
Central	19.00-over
Northeast	21.00-30.00
Northwest	19.00-25.00
Southwest	--
Southeast	13.00-21.00

Fringe Benefits:

Depending on the employer, geologists may receive paid vacations and holidays, life, accident, disability and hospitalization insurance, retirement plans and sick pay. These benefits are usually paid, at least in part, by the employer.

Career ladder for this occupation may look like this:

- Self-employed Consultant
- Program Manager
- Project Leader
- Geologist

EMPLOYMENT AND OUTLOOK

There were approximately 48,000 geologists employed nationally in 1992. In addition, thousands of persons held geology, geophysics and oceanography faculty positions in colleges and universities. Employment of geologists is expected to grow about as fast as the average through the year 2005.

In the past, most jobs for geologists and geophysicists were in or related to the petroleum industry, particularly in the exploration for oil and gas. However, this industry is subject to cyclical fluctuations and many experienced geologists and geophysicists have left the occupation due to recent slowing of exploration activities. The number of degrees granted in geology is also low and should openings in the oil industry increase, there will be more job positions than geologists or geophysicists to fill the positions.

Environmental protection and regulatory geoscience are becoming important fields of work for geoscientists. In particular, jobs requiring training in hydrology and geochemistry should be in demand.

Oklahoma Employment and Outlook

In Oklahoma, geologists and geophysicists are projected to have 65 job openings annually until the year 2000. Most of these job openings represent replacements caused by leaving the occupation, promotions, retirements, etc. rather than new job growth. In 1990, geologists and geophysicists held 1,631 jobs in Oklahoma. They are expected to hold 1,769 jobs by the year 2000. This is considered a slow growth rate.

Levels of education and training usually needed for this occupation:

- College - bachelor's degree
- College - master's degree

Levels of education and training also available for this occupation:

- College - Ph.D. or professional degree

School subjects helpful in preparing for this occupation:

- College preparatory
- Algebra
- Trigonometry
- Earth science
- Geography
- English
- Geometry
- Chemistry
- Physical science
- History

MORE SOURCES OF INFORMATION

- Ms. Marilyn Suiter
  Director of Education & Human Resources
  American Geological Institute
  4220 King Street
  Alexandria, VA 22302-1507

- American Assoc. of Petroleum Geologists
  P.O. Box 979
  Tulsa, OK 74101-0979

- Society of Exploration Geophysicists
  P.O. Box 702740
  Tulsa, OK 74170

- Geological Society of America
  3300 Penrose Place
  Box 9140
  Boulder, CO 80301

ELECTRICAL/ELECTRONICS ENGINEER

NATURE OF THE OCCUPATION

Electrical and electronics engineers conduct research and development activities in relation to the design, manufacture, testing and application of electrical and electronic components, products and systems.

Duties may include but are not limited to the following:

- Designing test apparatus
- Devising evaluation procedures
- Developing new and improved products
- Recommending equipment design changes
- Writing equipment specifications
- Writing performance requirements
- Directing field operations
- Developing maintenance schedules
- Solving operational problems

OCCUPATIONAL SPECIALTIES

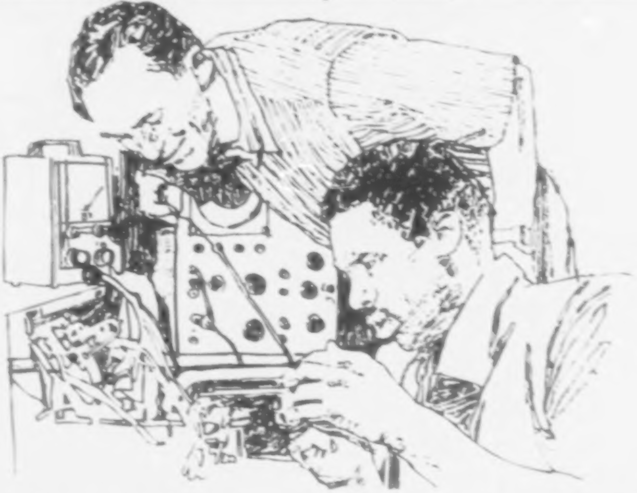
Electrical (003.061-026) and **Electronics** (003.061-038) **Research Engineers** conduct research in various areas of electrical and electronic applications.

Illuminating Engineers (003.061-046) design and direct installation of illuminating equipment and systems for buildings, plants, streets and other facilities.

Power System Electrical Engineers (003.167-018) design power system facilities and equipment and coordinate the construction, operation and maintenance of electric power generating, receiving and distribution stations, systems and equipment.

WORKING CONDITIONS

Electrical and electronics engineers usually work with other engineers, technicians and construction or manufacturing workers. They may work as part of a specialist team or supervise construction of factory workers.



Electrical and electronics engineers usually work in well-lighted and well-ventilated offices or laboratories. Others work in factories, power installations or out-of-doors. Electrical and electronics engineers may be required to relocate to work on different projects. Long-term projects may last two or three years.

Electrical and electronics engineers may join professional organizations such as the National Society of Professional Engineers or the Institute of Electrical and Electronics Engineers. Members pay annual dues.

You should like:

- Activities that are scientific and technical in nature
- Activities dealing with objects
- Activities relating to processes, machines and methods

You should be able to:

- Understand and use high-level mathematics
- Recognize differences in the size, shape and form of objects, lines and figures
- Work carefully and pay close attention to details
- Think logically
- Analyze and solve problems based on accurate information
- Make decisions
- Direct, control and plan activities
- Communicate effectively with others

Physically you must:

- Work with your hands and fingers
- See well, including color vision, either naturally or with correction
- Talk and hear

Special Requirements:

A Ph. D. degree is required for teaching in a college or university and is usually required for research positions in industry. Electrical and electronics engineers who have primary responsibilities for a project generally are required to be licensed.

Opportunities for Experience:

Scientific and technical hobbies may provide helpful experience in this area. Summer employment in electronics businesses and co-op programs in college offer excellent opportunities for experience. Opportunities are also available through branches of the military service.

BEST COPY AVAILABLE

ELECTRICAL/ELECTRONICS ENGINEER

Methods for Entry:

Methods of entering this occupation include direct application to employers and civil service exams. Positions may also be located by consulting newspaper want ads, professional publications, college placement offices and state employment offices.

EARNINGS AND ADVANCEMENT

Earnings depend upon the type, size and location of the employing organization and the employee's education, experience, capabilities and responsibilities.

Earnings:

In 1995, beginning electrical engineers with Bachelor's degrees earned average salaries of $35,943. Those with Master's degrees had beginning salaries averaging $42,394; and those with Ph.D. degrees earned starting salaries averaging $55,153. The average annual salary for experienced electrical engineers in 1995 was $60,442.

Oklahoma Salary:

Region	Range
Central	22.00-26.00
Northeast	14.00-23.00
Northwest	12.00-23.00
Southwest	--
Southeast	18.00-20.00

Fringe Benefits:

Depending on the employer, electrical and electronics engineers may receive paid vacations and holidays, paid sick leave, life, health, accident and disability insurance, and retirement plans. These benefits are usually paid for, at least in part, by the employer. Some employers may also provide educational reimbursements.

Career ladder for this occupation may look like this:

- Chief Engineer Manager
- Electrical and Electronics Engineer
- Electrical and Electronics Engineer Trainee

EMPLOYMENT AND OUTLOOK

There were approximately 370,000 electrical and electronics engineers employed nationally in 1992. Employment is expected to be good through the year 2005 due to the growing demand for computers, communications equipment, military electronics, and electrical and electronic consumer goods.

Electronic engineers who fail to keep up with the rapid changes in technology in some specialties risk technological obsolescence, which makes them more susceptible to layoffs or, at a minimum, likely to be passed over for advancement.

Oklahoma Employment and Outlook

In Oklahoma, electric and electronics engineers are projected to have 115 job openings annually until the year 2000. These job openings represent new job growth and replacements caused by leaving the occupation, promotions, retirements, etc. In 1990, electric and electronics engineers held 2,718 jobs in Oklahoma. They are expected to hold 3,316 jobs by the year 2000. This is considered an average growth rate.

Levels of education and training usually needed for this occupation:

- College - bachelor's degree
- College - master's degree

School subjects helpful in preparing for this occupation:

- Algebra
- Calculus
- Chemistry
- College preparatory
- Composition
- Cooperative education — trade and industrial drafting
- Electricity and electronics
- English
- Geometry
- Humanities
- Machine shop
- Physics
- Trigonometry

MORE SOURCES OF INFORMATION

- Institute of Electrical and Electronics Engineers (IEEE)
  Attn: Laura Durrett
  IEEE Regional Activities
  445 Hoes Lane
  Piscataway, NJ 08855

- Society of Women Engineers (SWE)
  120 Wall Street 11th Floor
  New York, NY 10017

- Institute of Electrical and Electronics Engineers (IEEE)
  Attn: Laura Durrett
  IEEE Regional Activities
  445 Hoes Lane
  Piscataway, NJ 08855

- JETS Guidance
  1420 King St., Suite 405
  Alexandria, VA 22314-2715

- National Engineering Consortium
  303 E. Wacker Drive
  Suite 740
  Chicago, IL 60601

NUCLEAR ENGINEER

NATURE OF THE OCCUPATION

Nuclear engineers participate in broad areas of analysis, design, management, and research using nuclear energy for power plants, transportation, space exploration, diagnostic health and environmental control of pollution. Some specialize in the development of nuclear weapons; others develop industrial and medical uses for radioactive materials.

Duties may include but are not limited to the following:
- Conducting research into problems of nuclear energy
- Designing and developing nuclear equipment
- Monitoring the testing, operation and maintenance of nuclear reactors
- Planning and conducting research to test theories of nuclear energy
- Evaluating findings to develop new uses of radioactive processes
- Preparing technical reports

OCCUPATIONAL SPECIALTIES

Nuclear Equipment Design Engineers (015.061-010) design nuclear machinery and equipment.

Nuclear Engineers (015.061-014) conduct research into problems of nuclear energy systems.

Nuclear Equipment Research Engineers (015.061-018) conduct research on nuclear machinery and equipment.

Nuclear Equipment Test Engineers (015.061-022) conduct tests on nuclear machinery and equipment.

WORKING CONDITIONS

Nuclear engineers usually work with others as part of an engineering team. Depending on the particular position, they may supervise other engineers, technicians, and other workers.

Nuclear engineers may work in comfortable offices and research laboratories. They generally work a 5-day, 40-hour week. Overtime may be required in case of emergencies or to meet deadlines.

Nuclear engineers may join professional organizations such as the American Nuclear Society or the National Society of Professional Engineers. Members usually pay dues.

Tools, equipment and materials used may include:
- Plans, designs, and specifications
- Calculators
- Computers
- Engineering reports

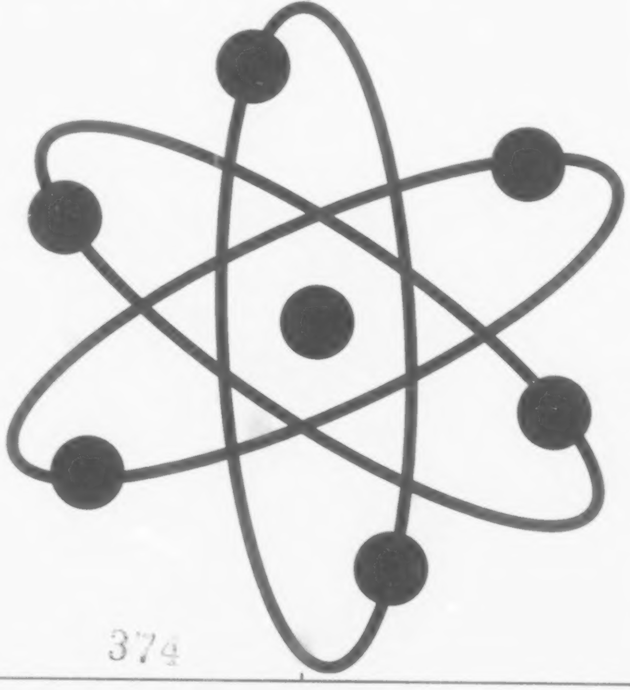
You should like:
- Activities of a scientific and technical nature

You should be able to:
- Work within precise limits or standards of accuracy
- Reason clearly and logically
- Perform mathematical operations quickly and accurately
- Visualize objects from diagrams
- Rate information by using personal judgment or measurable standards

Physically you must:
- See well, either naturally or with correction

Special Requirements:

All 50 states and the District of Columbia require registration for engineers whose work may affect life, health or property or who offer their services to the public. Registration generally requires a degree from an accredited engineering program, 4 years of relevant work experience and passing a state examination. Graduate training is required for engineering faculty, and it is helpful for other positions as a way to learn new technology and to enhance promotion opportunities.



NUCLEAR ENGINEER

Opportunities for Experience:

There are no opportunities for experience at the present.

Methods for Entry:

Methods of entering this occupation include direct application to employers and civil service offices. Assistance in locating a job may also be available from professional associations, college and university placement offices and local employment offices.

EARNINGS AND ADVANCEMENT

Earnings depend upon the employer and the education, experience capabilities, and job responsibilities of the employee.

Earnings:

Nuclear engineers with a bachelor's degree earned a starting salary of $39,438 in 1995; those with a master's degree received first-year offers averaging $44,843 per year. Highly experienced engineers working in the private sector may earn as much as $198,033.

Fringe Benefits:

Depending on the employer, nuclear engineers may receive paid vacations and holidays, sick leave, group health and life insurance, pension plans and reimbursement for further education. These benefits are usually paid, at least in part, by the employer.

Career ladder for this occupation may look like this:

- Chief Engineer and Supervisor
- Nuclear Engineer
- Engineering Trainee

Engineers usually advance to positions of greater responsibility after gaining experience.

EMPLOYMENT AND OUTLOOK

There were approximately 17,000 nuclear engineers employed nationally in 1992. Almost one-fifth were in the federal government. Engineers in the private sector worked for public utilities or engineering consulting firms. Employment of nuclear engineers is expected to change little through the year 2005. Because of concerns over the safety of nuclear power, few or no new nuclear power plants will be started by the year 2005. Nuclear engineers will be needed for the plants in operation or currently under construction; they will also be needed to work in defense related areas.

Oklahoma Employment and Outlook

In Oklahoma, nuclear engineers are projected to have 2 job openings annually until the year 2000. These job openings represent new job growth and replacements caused by leaving the occupation, promotions, retirements, etc. In 1990, nuclear engineers held 42 jobs in Oklahoma. They are expected to hold 48 jobs by the year 2000. This is considered an average growth rate.

Levels of education and training usually needed for this occupation:

- College - bachelor's degree
- College - master's degree
- College - Ph.D. or professional degree

School subjects helpful in preparing for this occupation:

- College preparatory
- Algebra
- Computer science
- Chemistry
- Blueprint reading
- English
- Calculus
- Math
- Physics

375

MORE SOURCES OF INFORMATION

- National Society of Black Engineers (NSBE)
  1454 Duke St., P.O. Box 25588
  Alexandria, VA 22314

- JETS-Guidance
  1420 King St., Suite 405
  Alexandria, VA 22314-2794

- Public Communications Dept.
  American Nuclear Society
  555 North Kensington Avenue
  La Grange Park, IL 60525

Student Supplement 1

AIRCRAFT MECHANIC

NATURE OF THE OCCUPATION

Aircraft mechanics or technicians, also known as *airframe-and-power-plant mechanics*, inspect, repair and service all types of aircraft engines and mechanical or hydraulic systems and components of airplaines.

Duties may include but are not limited to the following:

- Repairing, replacing and assembling aircraft parts and frames
- Maintaining or replacing hydraulic units, oxygen systems, fuel and oil systems, fire extinguisher systems and electrical systems
- Repairing electronic systems, such as computerized controls
- Maintaining and replacing aircraft engines, propeller pumps and fuel and oil and water injection systems
- Certifying that aircraft is ready for operation

OCCUPATIONAL SPECIALTIES

Airframe-and-Power-Plant Mechanics (621.281-014) service, repair and overhaul aircraft and aircraft engines to ensure air-worthiness. They read and interpret manufacturer and airline maintenance manuals to determine the method of repairing or replacing malfunctioning or damaged components.

Aircraft Maintenance Supervisors (621.131-014) supervise and coordinate the activities of airframe-and-power-plant mechanics. They train employees in work methods and procedures and inspect work to maintain specified standards and quality.

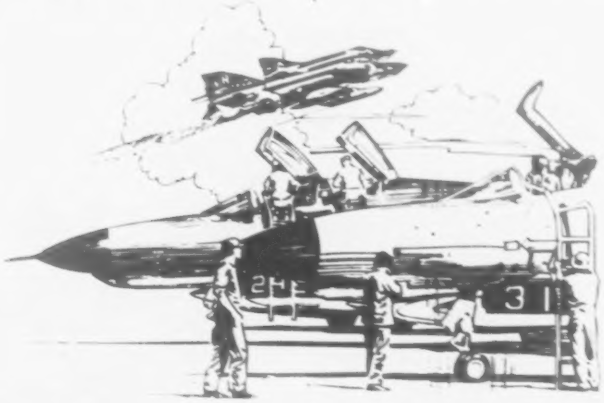
Experimental Aircraft Mechanics (621.261-022) inspect, test and are responsible for the maintenance and servicing of experimental and prototype aircraft, engines and components, as specified by the government agency or customer requirements.

Reclamation Workers (621.684-014) dismantle wrecked and other decommissioned aircraft, salvage parts and equipment and retain any usable parts, cleaning them in solvents and preservative.

WORKING CONDITIONS

Aircraft mechanics may work alone or with others under the direction of a supervisor. They usually work in hangars.

Aircraft mechanics usually work 40 hours a week on 8-hour shifts, which may include rotating shifts, and evening and weekend work. Mechanics often work under the pressure of time to maintain flight schedules.



Aircraft mechanics may join a union such as the International Association of Machinists and Aerospace Workers or the Transport Workers Union of America. Members usually pay dues.

Tools, equipment and materials used may include:

- Hydraulic test equipment
- Propeller test bench
- Magna flux test
- Power shears
- Arbor presses
- Air or electric drills
- Carburetor flow tester
- Blueprints/specifications
- Repair manuals
- Micrometers
- Voltmeters
- Pressure gauges
- Heat-treat equipment
- Drill presses
- Rivet guns
- Rules, tapes
- Center punches

You should like:

- Working with objects and machines
- Doing work that involves both physical and mental exercise

You should be able to:

- Work within precise limits or standards of accuracy
- Perform a variety of jobs that often change
- Visualize drawings or pictures as solid objects
- Recognize slight differences in shapes or shadings of objects

Physically you must:

- See and hear well, either naturally or with correction
- Climb onto aircrafts, ladders and scaffolds and maintain balance
- Be able to stoop, bend, kneel, crouch and crawl in sometimes awkward positions
- Use your hands easily and skillfully to reach, handle and position parts and use tools

BEST COPY AVAILABLE

AIRCRAFT MECHANIC

Special Requirements:

Mechanics who work on civilian aircraft must be licensed by the Federal Aviation Administration (FAA).

Opportunities for Experience:

Summer employment at small airports under the direction of a licensed mechanic, or FAA-approved college or vocational school course work in aircraft mechanics may provide opportunities. The military service also offers opportunities for experience in this area.

EARNINGS AND ADVANCEMENT

Earnings depend upon the employer, geographic location, union affiliation and mechanic's training, experience, seniority and responsibilities.

Earnings:

In 1995, the average yearly salary of first-year aircraft mechanics was $23,571. With more experience, aircraft mechanics earn up to an average of $30,801 yearly. Mechanics who work on jets generally earn more than those working on other aircraft.

Mechanics employed by the federal government earned an average yearly salary of $37,700 in 1995. Apprentice mechanics usually start at 50 percent of journeymen wages and work up to full scale pay after 3 years.

Oklahoma Salary:

Region	Range
Central	17.00-21.00
Northeast	9.00-13.00
Northwest	--
Southwest	--
Southeast	--

Fringe Benefits:

Depending on the employer, aircraft mechanics may receive paid vacations and holidays, sick leave, life, health, disability, hospitalization and dental insurance and retirement plans. These benefits are usually paid, at least in part, by the employer. Airline mechanics may also receive free or reduced rates on flights and uniform cleaning allowances.

Career ladder for this occupation may look like this:

- Inspector
- Crew Chief
- Licensed Aircraft Mechanic
- Apprentice

Aircraft mechnics may advance through further training and experience.

EMPLOYMENT AND OUTLOOK

Aircraft mechanics held about 131,000 jobs in 1992. Employment of aircraft mechanics is expected to grow at a slower rate than other occupations through the year 2005. Because the airlines offer relatively high wages and attractive travel benefits, competition for jobs with them can be anticipated. Job opportunities will be best in general aviation, particularly for experienced mechanics.

Mechanics who keep up on technological advances in electronics and other areas will be in greater demand. Opportunities in the federal government will depend upon changes in defense spendings.

Oklahoma Employment and Outlook

In Oklahoma, aircraft mechanics are projected to have 69 job openings annually until the year 2000. These job openings represent new jobs and replacements caused by leaving the occupation, promotions, retirements, etc. In 1990, aircraft mechanics held 1,893 jobs in Oklahoma. They are expected to hold 2,160 jobs by the year 2000. This is considered an average growth rate.

Levels of education and training usually needed for this occupation:

- Technical, junior or community college
- Apprenticeship

Levels of education and training also available for this occupation:

- On-the-job training
- High school diploma or G.E.D.
- High school diploma with vocational education

School subjects helpful in preparing for this occupation:

- Algebra
- Chemistry
- Electricity and electronics
- Trigonometry
- Blueprint reading
- Machine shop

MORE SOURCES OF INFORMATION

- ATEC
  (Aviation Technician Ed. Council)
  2090 Wexford Ct.
  Harrisburg, PA 17112

- Federal Aviation Administration
  800 Independence Avenue SW
  Washington, DC 20591

- Future Aviation Professionals of America
  4959 Massachusetts Blvd.
  Atlanta, GA 30337

- Professional Aviation Maintenance Association
  500 Northwest Plaza, Suite 1016
  St. Ann, MO 63074-2209

- Aviation Maintenance Foundation, International
  P.O. Box 2826
  Redmond, WA 98073

Career-Exploration Process
Unit 5

Assignment Sheet 3—Gather Specific Job Information

Name ______________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	______
Content is relevant and well organized.	______
Overall rating	______

Evaluator's comments ________________________________

____

____

Introduction

Step 4 in the career decision-making process is gathering specific job information about the jobs in the occupational area you have chosen to explore. Finding job information is easier than you might think. You can gather information by reading printed materials or by going through a computerized job search. Each of these sources of information is discussed below.

Government publications

Government publications such as the *Occupational Outlook Handbook*, *Dictionary of Occupational Titles*, and the *Guide for Occupational Exploration* are excellent source materials for finding information about specific jobs.

Occupational Outlook Handbook. The *Occupational Outlook Handbook* (OOH) is published by the U.S. Department of Labor and includes general information on approximately 200 occupations. The handbook provides information about job duties, working conditions, level and places of employment, education and training requirements, advancement possibilities, job outlook, earnings, and related occupations.

You should begin your job-information search in this publication by reading the section titled "How To Get the Most From the Handbook" and then browse through the table of contents, where related occupations are grouped in clusters, or look in the alphabetical index for occupations that interest you.

The numbers in parentheses that appear just below the title of most occupational statements in the OOH are called *DOT* codes. DOT stands for *Dictionary of Occupational Titles*, another Department of Labor publication. Each DOT number classifies jobs by the type of work, required training, physical demands, and working conditions. DOT numbers are included in

Assignment Sheet 3

the OOH because some career-information centers and libraries use them for filing occupational information. An index in the OOH cross-references the DOT numbers to occupations covered in the OOH.

Dictionary of Occupational Titles (DOT). The *Dictionary of Occupational Titles* defines and classifies approximately 20,000 occupations performed in the United States' economy. The DOT groups jobs into occupations based on their similarities. It also defines the job characteristics of all listed occupations. An occupational definition in the DOT normally has six basic parts. Each part represents information about a job in a systematic fashion. The parts are (1) a nine-digit occupational code number (DOT code), (2) the occupational title, (3) the industry or industries in which the occupation is found, (4) other titles by which the occupation also may be known, (5) a description of the tasks performed, and (6) related occupations.

Guide for Occupational Exploration (GOE). The *Guide for Occupational Exploration* is a U.S. Employment Service publication designed to provide you with information about fields of work that match your own interests and abilities. The GOE organizes occupational descriptions into 12 interest areas, 66 work groups, and 348 subgroups. Each description contains a general overview of the occupational area, followed by sections that answer the following questions:

- What kind of work would you do?
- What skills and abilities do you need for this kind of work?
- How do you know if you would like or could learn to do this kind of work?
- How can you prepare for and enter this kind of work?
- What else should you consider about these jobs?

The three government publications described may scare you at first because they are large. But these publications are probably the most well-known and often-used sources of occupational information available, and with a little practice and help from your school librarian or counselor, they can become your most valuable career-information tools.

Books and magazines

Many school- and public-library collections include sections of current career information in the form of pamphlets, newspapers, books, and magazines. Most of these small career-information publications are published by the federal government or by the state where you live. Ask your school or local librarian to help you locate this helpful information.

Computerized guidance programs

Your school library or guidance center may have a computerized guidance program. Most computerized programs are self-paced, fun to do, and contain much information about many types of jobs. If such a program is not available in your school, ask your technology-education teacher to check into the vocational guidance information available in your state. For example, in Oklahoma, career information can be obtained through the computerized system provided by the Career Search division at the Oklahoma Department of Vocational and Technical Education in Stillwater, Oklahoma. See examples of the printouts provided by this service in Student Supplement 1, "Career Search Booklet." Similar programs are available in other states.

Assignment Sheet 3

What you want to know

Before you start gathering specific job information, you should review your lists of skills, aptitudes, and other personal information you gathered in Assignment Sheet 1. Keep this information handy as you gather job information. Refer to it whenever you need to refresh your memory about your needs. Remember, you are gathering job information to find a career that fits *you*.

Next, use a standard form for gathering information about specific jobs. By using a standard form, you can easily compare and evaluate the jobs you research.

The following are the topics you will want to include on the standard form you use for job research.

- The nature of the occupation (job duties)
- Working conditions
- Any worker requirements (things you should like and things you should be able to do) on the job
- Typical earnings and opportunities for advancement
- Your chances for employment in the job and the employment outlook for the job
- The educational and training required for success on the job

Exercise **Complete job report forms**

Directions

Your goal in this exercise is to complete Step 4 in the career decision-making process: Gather and compare specific information on jobs in the occupational area you have chosen to explore. To do so, you will make five copies of Student Supplement 2, "Job-Information Report Form," (see page 251) research five jobs, and fill out one report form for each job researched.

Turn in your five report forms to your instructor when complete.

Career-Exploration Process
Unit 5

Student Supplement 2—Job-Information Report Form

Directions Use the following form for gathering and comparing information about the specific jobs you wish to explore in Assignment Sheet 3.

Nature of the occupation ____________________

Working conditions ____________________

Student Supplement 2

Worker requirements ____________________

Earnings and opportunities ____________________

Student Supplement 2

Employment outlook

Education/training required

Career-Exploration Process
Unit 5

Assignment Sheet 4—Make a Career Decision

Name ______________________ Date ____________

Evaluation criteria **Rating**

Directions have been followed. ______

Content is relevant and well organized. ______

Overall rating ______

Evaluator's comments ______________________

Introduction

Making a career decision is Step 5 in the career-exploration process. It is important that you learn to make good decisions in all areas of your life. But learning to make good decisions in some areas of your life can even be critical.

Choosing a career is a very complex decision that presents you with many options and will ultimately affect many areas of your life. Because of this, you should take a great deal of time and care in reviewing and coming to a final career decision.

Remember though, decision making is a skill, and like any other skill you get better at it through practice. So the decision-making skills you are practicing now will carry over into your later life. And, you will profit from the decision-making skills you have practiced in this exercise.

Exercise **Job comparison**

Directions Your goal in this exercise is to select a career goal—one job from the five jobs you gathered specific information about in Assignment Sheet 3. To do so, you will consider your five options by completing the steps below and on the next page.

Activity checklist Put a checkmark on the blank line before each activity below as you complete it.

______ 1. Look at the information you have gathered on each of the five "Job-Information Report Forms" you filled out in Assignment Sheet 3. Then, try to imagine as clearly as possible what it would be like to actually be working at each of these jobs. Think of the advantages and disadvantages of each job. Try to imagine which job seems to best meet your needs.

_______ 2. Complete Student Supplement 3, "Job-Comparison Worksheet" on page 257.

- In the boxes under the column headed "Job choice," list the five jobs you reported on in Assignment Sheet 3.
- In the boxes under the column headed "Advantages," list beside each job choice the advantages you imagine each job would have.
- In the boxes under the column headed "Disadvantages," list beside each job choice the disadvantages you imagine each job would have.
- Review your lists of advantages and disadvantages. Write a checkmark beside any advantage or disadvantage that seems especially important to you.

_______ 3. Carefully review Student Supplement 3, "Job-Comparison Worksheet," and try to decide which choice seems to have the best chance of meeting your personal needs. Then, on the blanks below, rank the five jobs you have explored.

Career goal—First choice ______________________________

Second choice ______________________________

Third choice ______________________________

Fourth choice ______________________________

Fifth choice ______________________________

Career-Exploration Process
Unit 5

Student Supplement 3—Job-Comparison Worksheet

Directions In the boxes under the column heading "Job choice," list the five jobs you reported on in Assignment Sheet 3. In the boxes under the column heading "Advantages," list beside each job choice the advantages you imagine each job would have. In the boxes under the heading "Disadvantages," list beside each job choice the disadvantages you imagine each job would have.

Job choice	Advantages	Disadvantages
1.		
2.		

Student Supplement 3

Job choice	Advantages	Disadvantages
3.		
4.		
5.		

Career-Exploration Process
Unit 5

Assignment Sheet 5—Develop Plan of Action to Meet Career Goal

Name ______________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	______
Content is relevant and well organized.	______
Overall rating	______

Evaluator's comments ____

____

____

Introduction

We all have good intentions of meeting the career goals we have set for ourselves. But we do not always develop objectives and set time frames for meeting our goals. We become procrastinators—people who put things off.

By learning to develop objectives and set time frames for meeting goals, you develop a career plan of action. You help yourself get out of the habit of putting things off. You learn to do things when they need to be done.

Career *objectives* are specific actions or steps you will take to meet your career goal. Three factors should be taken into account when you determine your career objectives:

- The level of education and training you will need to meet your career goal.
- Money you may need for education or equipment.
- Jobs leading to your career goal.

There are two time frames for taking action on the objectives you plan to achieve: short-term and long-term. A *short-term objective* is any objective you can accomplish in a year's time. An example of a short-term objective could be to complete this course. A *long-term objective* is one that takes more than a year's time to complete. An example of a long-term objective could be to graduate from high school.

Exercise **Personal career plan of action**

Directions Take out the information you gathered on the career of your choice. Also, locate Student Supplements 4 through 8 on pages 261 through 272. Then, complete each of the following steps.

Assignment Sheet 5

Activity checklist Write a checkmark on the blank line before each activity below as you complete it.

________ 1. In the blank at the top of Student Supplement 4, "Career Objectives," write down your career goal. Then, using the job information you gathered, list under the proper heading the education and training you will need, money you may need for your education and training or equipment, and jobs leading to your ultimate career goal. Do not worry about putting the lists in order yet. Just write down everything that will lead you toward your career goal. These lists become your career objectives.

________ 2. Take out Student Supplements 5, 6, and 7 and the list of objectives you completed on Student Supplement 4.

- On Student Supplement 5, "What You Can Do This Year," make a list of your short-term objectives. Select short-term objectives from Student Supplement 4 and sort and list these under the proper heading on Student Supplement 5.
- On Student Supplement 6, "What You Can Do in High School," make a list of your long-term objectives that can be completed while you are in high school. Select these objectives from Student Supplement 4 and sort and list these under the proper heading on Student Supplement 6.
- On Student Supplement 7, "What You Can Do After High School," make a list of the long-term objectives you will complete after you graduate from high school. Select these objectives from Student Supplement 4 and sort and list these under the proper heading on Student Supplement 7.

________ 3. Go back over Student Supplements 5, 6, and 7 and assign dates to each objective. For short-term objectives, you should be able to list exact dates. For long-term objectives, you may only be able to estimate the year.

Once you have assigned dates and estimated years to complete each objective, you may see that some of your objectives interfere with one another. If this happens, make adjustments, or if adjustments cannot be made, you will have to decide which objective is more important.

________ 4. Once you have sorted and listed your objectives to meet your needs, fill out Student Supplement 8, "Career Plan of Action."

Remember, you should review and revise your career plan of action as needed in the future. Your career plan is not carved in stone. Make it flexible. But, try not to change it for foolish reasons. Think about what you are doing.

Career-Exploration Process
Unit 5

Student Supplement 4—Career Objectives

Directions In the blank provided below, write your career goal. Then, using the job information you have gathered, list under the proper heading the education and training you will need, the equipment you will need, and jobs you think you will need to obtain in order to reach your career goal. These lists will become your career objectives.

Career goal ____

Education and training required to meet your career goal

Student Supplement 4

Equipment needed to meet your career goal

Student Supplement 4

Jobs required to meet your career goal

Career-Exploration Process
Unit 5

Student Supplement 5—What You Can Do This Year

Directions Review the three lists you made in Student Supplement 4, and then select short-term objectives from those lists. Write these short-term objectives under the proper heading on this form.

Short-term objectives for education and training needed to meet your career goal

Short-term objectives for equipment needed to meet your career goal

Student Supplement 5

Short-term objectives for jobs required to meet your career goal

Career-Exploration Process
Unit 5

Student Supplement 6—What You Can Do in High School

Directions Review the three lists you made in Student Supplement 4, and then select from those lists long-term objectives you can meet while you are in high school. Write these long-term objectives under the proper heading on this form.

Long-term educational and training objectives you can meet while you are in high school

Long-term equipment-need objectives you can meet while you are in high school

Student Supplement 6

Long-term job objectives you can meet while you are in high school

Career-Exploration Process
Unit 5

Student Supplement 7—What You Can Do After High School

Directions Review the three lists you made in Student Supplement 4, and then select from those lists long-term objectives you can meet after you graduate from high school. Write these long-term objectives under the proper heading on this form.

Long-term educational and training objectives you can meet after you graduate from high school

Long-term equipment-need objectives you can meet after you graduate from high school

Student Supplement 7

Long-term job objectives you can meet after you graduate from high school

Career-Exploration Process
Unit 5

Student Supplement 8—Career Plan of Action

Directions Review the lists you have made in Student Supplements 5, 6, and 7 and assign dates to each objective. Using these lists and dates, complete this form by listing all your objectives according to the dates you have assigned.

Career goal ______________________________

Year	Objective

Student Supplement 8

Year	Objective

Evaluating the Consequences of Using Technology
Unit 6

Objective Sheet

Unit objective

After completing this unit, the student should be able to use a futuring process to evaluate the consequences of using a technology. The student will demonstrate these competencies by completing the assignment sheets and the lab activity sheet and by scoring a minimum of 85 percent on the written test.

Specific objectives

After completing this unit, the student should be able to

1. Discuss why people must evaluate their use of technology.
2. List two of the undesired consequences of using technology.
3. Define the term *futuring process.*
4. Evaluate the consequences of your television-watching habits. (Assignment Sheet 1)
5. Evaluate the consequences of your family's present recycling habits. (Assignment Sheet 2)
6. Collect a sample of the particulate matter in the air. (Lab Activity Sheet 1)

Evaluating the Consequences of Using Technology
Unit 6

Information Sheet

1. **Why people must evaluate their use of technology**

- **People use a technology to solve a problem.**

  Example: People use the gas-powered automobile to solve the problem of needing to transport themselves from one place to another in a relatively cheap and convenient manner.

- **When people use a technology to solve a problem, there are consequences—some consequences are anticipated and desired; other consequences are not anticipated or desired.**

  Example: The use of the gas-powered automobile has brought the anticipated and desired consequences of providing transportation for all people and allowing people access to more jobs because they can get to those jobs easily; however, people's continued and extensive use of the automobile has also brought the unanticipated and undesired consequences of air pollution and the possible "greenhouse effect."

- **People must evaluate both the desired and undesired consequences of using a technology and decide if the continued use of a technology is appropriate in a given situation.**

2. **Two of the undesired consequences of using technology**

- **Negative impact on the environment**

  Examples: Air pollution, water pollution, soil pollution

- **Negative impact on society**

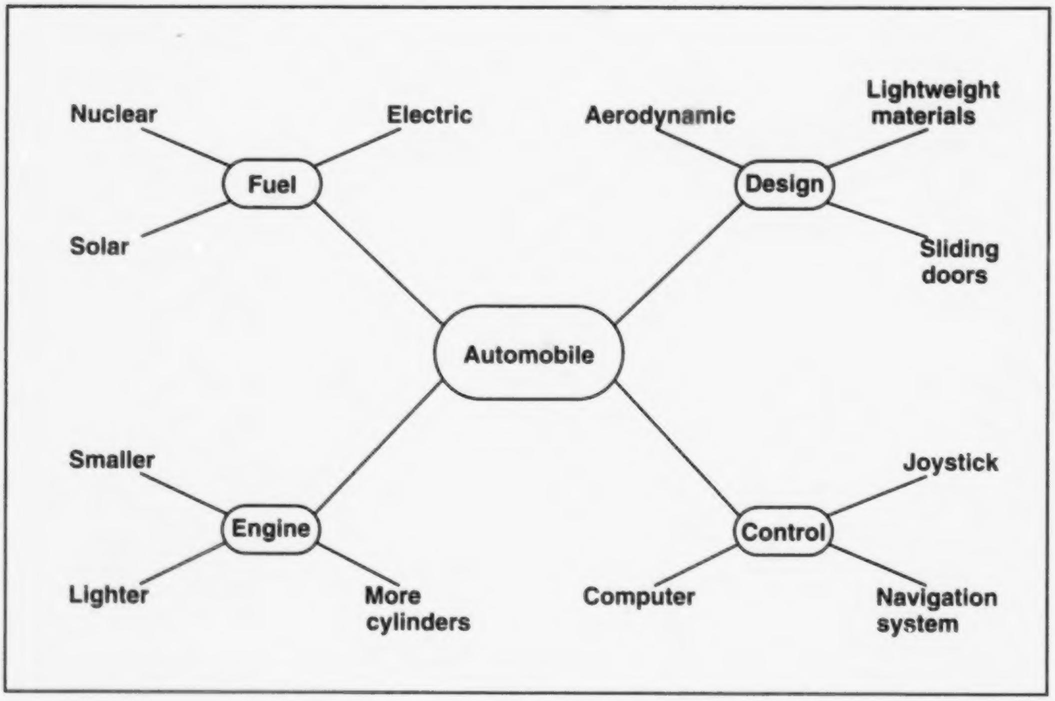
  Example: Some people believe that the unlimited use of the television by the family members in the American society is contributing to the breakdown of communication seen in American families.

3. **Definition of *futuring process***—Process of projecting possible future consequences of using a technology and analyzing the possible effects of each consequence

   Note: One of the tools used in the futuring process is called a *futures wheel* in which you start with a product of technology (such as the automobile, as shown in Figure 1 on the next page) and project future consequences of its use.

Information Sheet

Figure 1: Sample futures wheel showing possible modifications to the automobile to solve present design problems


Nuclear
Electric
Fuel
Solar
Aerodynamic
Lightweight materials
Design
Sliding doors
Automobile
Smaller
Engine
Lighter
More cylinders
Joystick
Control
Computer
Navigation system

Evaluating the Consequences of Using Technology
Unit 6

Assignment Sheet 1—Evaluate the Consequences of Your Television-Watching Habits

Name ______________________ Date ____________

Evaluation criteria	**Rating**
Directions have been followed.	______
The logs completed in Part A are neat, accurate, and complete.	______
The graphs completed in Part A are neat and well organized visually and effectively illustrate the information presented in the completed logs.	______
The consequences lists completed in Part B are relevant and well thought out and present both desired and undesired consequences fairly.	______
The futures wheels completed in Part B are neat and well organized visually and effectively illustrate the consequences of the student's television-watching habits.	______
Overall rating	______

Evaluator's comments ____

____

____

Introduction As you learned by reading the information sheet, the use of a product of technology can produce both desired and undesired consequences. As you also learned, some of the undesired consequences of using technology are the negative impact technology may have on the environment and on society.

In this assignment sheet, you will evaluate the consequences your television-watching habits may be having on the micro-society of your family. You will begin the evaluation process by keeping a daily log of your personal habits (including your television-watching habits) for one week, and then, by drawing two graphs that will help you further analyze your habits. Next, you will be asked to draw two futures wheels to project the possible future consequences of your present television-watching habits.

Assignment Sheet 1

Exercise

Part A **Study your present television-watching habits.**

Activity checklist Put a checkmark on the blank line before each activity below as you complete it.

_______ 1. For a week, **keep a daily log** of the amount of time (hours and minutes) you spend in each of the following activities:

Watching TV
Talking to family members
Talking to friends
Exercising
Working
Reading
Doing homework

Title this log "Daily Activities."

_______ 2. During the same week, **keep another daily log** of the title, subject content, and the amount of time (hours and minutes) you spend watching each television program you watch.

Title this log "Daily Television-Watching Activities."

_______ 3. At the end of the week, **create a graph** that illustrates the amount of time (hours and minutes) you spent in each of the activities listed in the log you completed in Step 1 above.

_______ 4. At the end of the week, **also create a graph** that illustrates the information you collected in the log you completed in Step 2 above: the subjects of the television programs you watched and the amount of time you spent watching each type of program.

_______ 5. **Turn in your two daily logs and graphs** to your instructor.

_______ 6. Your instructor will return your graphs and logs with suggestions for improvement. **Make the improvements** your instructor suggests, and then, return your log and graphs to your instructor for **final evaluation**.

Part B **Evaluate the consequences of your television-watching habits.**

Television is one example of a product of technology that has consequences and choices associated with its use (whether or not to turn it on or off, how much to watch, what to watch). After completing Part A of this assignment, you should be able to understand some of the consequences of watching television.

Assignment Sheet 1

Activity checklist Put a checkmark on the blank line before each activity below as you complete it.

_______ 1. Study the logs and graphs of your habits that you completed in Part A of this assignment. Then, get two sheets of paper. On one sheet of paper, **list** what you believe are **desirable consequences** of your present television-watching habits. On the other sheet of paper, **list** what you believe are the **undesirable consequences** of your present television-watching habits.

_______ 2. After studying the lists you completed in Step 1, **draw a futures wheel** projecting future desirable consequences of your present television-watching habits.

_______ 3. After studying the lists you completed in Step 1, **draw a futures wheel** projecting future undesirable consequences of your present television-watching habits.

_______ 4. **Turn in your lists and your futures wheels** to your instructor.

_______ 5. Your instructor will return your lists and futures wheels with suggestions for improvement. **Make the improvements** your instructor suggests, and then, return your lists and futures wheels to your instructor for **final evaluation**.

Evaluating the Consequences of Using Technology
Unit 6

Assignment Sheet 2—Evaluate the Consequences of Your Family's Present Recycling Habits

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
Directions have been followed.	______
The log completed in Part A is neat, accurate, and complete.	______
The answers to the analysis check in Part A are relevant and well thought out.	______
The consequences lists completed in Part B are relevant and well thought out and present both desired and undesired consequences fairly.	______
The futures wheels completed in Part B are neat and well organized visually and effectively illustrate the consequences of the student's recycling habits.	______
Overall rating	______

Evaluator's comments ______________________________

____

____

Introduction

As you learned by reading the information sheet, one of the undesired consequences of using technology is the negative impact technology may have on the environment. In this assignment sheet, you will evaluate the consequences your family's recycling habits may be having on your local environment.

You will begin your evaluation process by keeping a daily log of your family's recycling habits for one week, and then, by answering some questions that will help you further analyze your family habits. Next, you will be asked to draw a futures wheel to project the possible future consequences of your present recycling habits.

Assignment Sheet 2

Exercise

Part A **Study your family's present recycling habits.**

Activity checklist Put a checkmark on the blank line before each activity below as you complete it.

________ 1. **Read** Student Supplement 1, "Environmental Primer" on page 285.

________ 2. For a week, **keep a daily log** of all the items your family throws away. In your log, classify each item as being recyclable or nonrecyclable, and describe how your family members were going to get rid of the item (was it placed in a bin to be recycled or was it placed in a bin to be sent to the landfill). On your list, be sure to note any toxic materials that your family has thrown away and also note how your family members were going to get rid of these items (were they in proper containers and going to be disposed of according to local codes).

________ 3. At the end of the week, review your log, and then, on a separate sheet of paper **answer the questions in the Analysis Check** on the next page.

________ 4. **Turn in your daily log and** your **answers** to the analysis check to your instructor.

________ 5. Your instructor will return your log and answers to the analysis check with suggestions for improvement. **Make the improvements** your instructor suggests, and then, return your log and answers to your instructor for **final evaluation**.

Part B **Evaluate the consequences of your family's recycling habits.**

Activity checklist Put a checkmark on the blank line before each activity below as you complete it.

________ 1. **Study your log and answers** to the questions in the analysis check. Then, get two sheets of paper. On one sheet of paper, list what you believe are desirable consequences of your family's present recycling habits. On the other sheet of paper, list what you believe are the undesirable consequences of your family's present recycling habits.

________ 2. After studying the lists you completed in Step 1, **draw a futures wheel** projecting future desirable consequences of your family's recycling habits.

________ 3. After studying the lists you completed in Step 1, **draw a futures wheel** projecting future undesirable consequences of your family's recycling habits.

Assignment Sheet 2

________ 4. **Turn in your lists and** your **futures wheels** to your instructor.

________ 5. Your instructor will return your lists and futures wheels with suggestions for improvement. **Make the improvements** your instructor suggests, and then, return your lists and futures wheels to your instructor for **final evaluation**.

Analysis Check

1. Where does the trash your family sets out on the curb eventually end up?
2. What resources are used in your area to reclaim recyclable materials?
3. What are the local codes used in your area for handling toxic substances?
4. What percentage (by volume) of the items your family disposed of were recyclable?
5. What percentage (by volume) of the items your family disposed of were not recyclable?
6. Were the items logged in as "toxic" handled properly by your family members?
7. What suggestions could you make to your family members for reducing the volume of the items your family disposes of weekly?
8. What suggestions could you make to your family members for properly handling toxic substances?

Evaluating the Consequences of Using Technology
Unit 6

Student Supplement 1—Environmental Primer

Introduction

A *primer* is "a small introductory book on a subject." The following sections make up a primer on the environment and include (1) terms and definitions associated with the study of the environment and (2) environmental-conservation activities you can practice in your home.

Terms and definitions

- **Biodegradable material**—Material that decomposes in the environment as a result of biological action (action of microorganisms)

  Note: Biodegradable materials vary in the amount of time required for them to degrade. Some biodegradable materials degrade in a few weeks; some biodegradable materials require thousands of years before they degrade; but some biodegradable materials (such as many of the materials commonly found in a landfill) will never degrade unless they are exposed to sunlight or oxygen.

- **Conservation**—Planned management of a natural resource that minimizes waste and maintains that resource for future use
- **Environment**—Natural surroundings including physical, chemical, and living factors such as soil, climate, plants, and animals
- **Pollution**—Reduction in the quality of the environment by the introduction of impurities
- **Recycle**—To transform waste products into new products
- **Toxic**—Poisonous; hazardous to plant and animal life even at very low concentrations
- **Waste**—Useless, unwanted, or discarded material

Types of environmental pollution

- **Air pollution**

  Examples: Automobile exhaust, industrial emissions, dust, smoke

- **Water pollution**

  Examples: Domestic sewage entering waterways before proper treatment; industrial waste improperly disposed of in landfills

- **Land (soil) pollution**

  Examples: Toxic waste such as pesticides, acid rain, solid wastes improperly disposed of on the land

Student Supplement 1

Environmental-conservation activities

Air-conservation activities

- Since gas-powered automobiles are major air polluters, reduce the amount of pollutants your automobile adds to the air by keeping your automobile tuned up, changing fuel filters often, maintaining emission-control devices, and using unleaded gasoline.

- Drive less; ride more. Use mass-transit, car pool, ride a bicycle, or walk to work or school.

  Note: The less you use your automobile, the less pollutants it can put into the environment.

- Avoid using cleaning products (such as oven cleaners and window cleaners) that release toxic chemicals into the air. Instead, use non-toxic cleaning products such as water, soap, baking soda, and vinegar.

- Plant trees. Trees help to purify the air by using up carbon dioxide in the air and by adding oxygen to the air.

Water-conservation activities

- Take short showers instead of baths.

  Note: Short showers use less water than baths.

- Use low-flow shower heads on all showers.

- Use faucet aerators at each sink.

- Run your washing machine and dishwasher only when they are fully loaded.

- Run water from the faucet only when necessary to wet or rinse when you are washing your hands or brushing your teeth.

  Note: The average home faucet allows 5 gallons of water to flow per minute.

- Fix leaky faucets or toilets.

- Water plants and lawns only as needed, and only water them in the morning to reduce water evaporation.

Soil- (land-) conservation activities

- Keep soil covered with grass, ground covers, trees, and other plant material to prevent erosion.

- Reduce household waste that would normally go to the landfill. Recycle as much as possible, and buy products that are recyclable.

Student Supplement 1

- Do **not** send toxic substances such as motor oil, pesticides, or old batteries to a landfill. Call your fire department and learn your local codes for the proper disposal of toxic substances.

Energy-conservation activities

- Use caulking and weather stripping to seal leaks and cracks around doors and windows.
- Increase the insulation in your home to meet the maximum recommendation for your area.
- Drive fuel-efficient vehicles.
- Use mass-transit, car pool, bike, or walk as much as possible.

  Note: Using these forms of transportation decreases fuel use and decreases the amount of pollutants in the air.
- Set your water heater at 120 degrees F.
- Use a cooler water-temperature setting for both the wash and rinse cycle on your washing machine.
- When using the heating system in your home, set it at a lower setting at night.
- Use fluorescent lights instead of incandescent lights.

  Note: Fluorescent lights use one-fourth the energy required for incandescent lights.
- Turn lights and appliances such as the television off when you are not present in the room.
- Adjust your refrigerator to a temperature setting between 38 and 42 degrees F, and fix any leaks in the seal around the refrigerator door.
- Purchase only energy-saving appliances with high-efficiency ratings.
- Use microwave ovens and pressure cookers rather than conventional ovens and regular top-of-the-range pots or pans.

  Note: Microwave ovens and pressure cookers use less energy and save time.
- Use alternative energies (solar and wind power) when possible to lessen the use of nonrenewable energies (fossil fuels).
- Use products that are recycled, recyclable, repairable, refillable, reusable, and long lasting.

  Note: Less energy is required to recycle or reuse a product than to manufacture a new product from raw material.

Student Supplement 1

Recyclable materials

- **Paper**

  Examples: Newspaper, corrugated boxes, office paper, mixed papers

- **Plastics**

  Examples: Milk containers, soft-drink containers, and other product containers

- **Glass**

  Examples: Bottles and jars

- **Aluminum**

  Examples: Cans and other product containers

- **Steel**

  Examples: Appliances made with steel casings

- **Scrap metal**

  Examples: Food cans

- **Wood**

  Examples: Pallets, solid-wood furniture, lumber

- **Motor oils**

- **Compost**

  Examples: Leaves, grass, brush, organic food wastes other than meat, paper contaminated with food

Nonrecyclable materials

- **Wastes heavily contaminated by food residues, household chemicals, or dirt**

- **Composite materials** (materials that cannot be separated)

  Examples: Aseptic boxes made of paper, foil, and adhesives; plastic-coated paper; furniture made from laminates; paper with a glossy varnished finish (such as used on magazine covers)

Evaluating the Consequences of Using Technology
Unit 6

Lab Activity Sheet 1—Collect a Sample of the Particulate Matter in the Air

Introduction

Health officials who are trained to use air-sampling equipment collect data concerning the quality of air in a particular area. If these officials find that a health hazard exists as a result of air pollution, they issue pollution alerts that are announced on local radio and television.

In completing this lab activity, you will have an opportunity to collect data on the particulate (of or relating to minute separate particles) matter in the air such as dust particles and smoke particles. Then, you will again draw future wheels that evaluate the consequences of the particulate matter in the air in your area.

Procedure

Put a checkmark on the blank line before each step below as you complete it.

________ 1. Your instructor will divide your class into groups of two, and he or she will provide you and your partner with the following materials.

- one 8-x-10-inch piece of white poster board attached to a wooden stake
- clear petroleum jelly

________ 2. Review the following worksheet associated with this lab activity.

________ 3. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the information you have listed for performing the procedure.

________ 4. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

________ 5. Perform the procedure:

- Take your poster board to the location your instructor has pre-approved and drive the poster-board stake into the ground.
- Thinly and evenly coat the white side of the poster board with the petroleum jelly.
- Observe the poster board each day over a period of one week. Keep a daily log of your observations (note how the poster board changes color, note the type and amount of particulate matter collected, etc.)

Lab Activity Sheet 1

_______ 6. Write a report summarizing your observations. Include in your report what you believe are the potential sources of the particulate matter you collected on the poster board. The report can be no longer than two pages.

_______ 7. Turn in your air sample, your log, and your report to your instructor.

_______ 8. Your instructor will return your log and your report with suggestions for improvement. Make the improvements your instructor suggests, and then, return your log and your report to your instructor for final evaluation.

Your instructor will rate your performance using the evaluation criteria listed in Part B on the worksheet.

_______ 9. Draw futures wheels projecting the future desirable and undesirable consequences of the particulate matter in the air in your area.

_______ 10. Turn in your futures wheels to your instructor.

_______ 11. Your instructor will return your futures wheels with suggestions for improvement. Make the improvements your instructor suggests, and then, return your futures wheels to your instructor for final evaluation.

Your instructor will rate your performance using the evaluation criteria listed in Part B on the worksheet.

Lab Activity Sheet 1

Worksheet—Collect a Sample of the Particulate Matter in the Air

Name ______________________________ Date ____________________

Part A: Pre-performance check

Complete the following information concerning the design of the collection methods you will use to collect your sample of the particulate matter in the air.

- Research, and then in the space provided below, list the potential sources of particulate air pollution in your local area.

- Select a site that you believe would be a good location for collecting a sample of the particulate matter in the air in your local area. In the space below or on a separate sheet of paper, describe that site and draw a diagram of the place where you will collect the sample.

416

Instructor's signature ______________________________

Lab Activity Sheet 1

Worksheet—Collect a Sample of the Particulate Matter in the Air

---

Part B: Performance evaluation

Evaluation criteria	**Rating**
Air-sample-collection procedure was completed correctly and accurately.	______
The observations log is neat, accurate, and complete.	______
The report effectively summarizes the information presented in the completed log.	______
The futures wheels are neat and well organized visually and effectively illustrate the consequences of particulate matter's presence in the air.	______
Overall rating	______

Evaluator's comments ____

____

____